



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

**MULTI-STEP BIDDING PROCESS
FOR
CONTRACTORS**

**Request For Solicitation For
Construction Services**

Stage II – Mechanical Contractors Bidders List

November 8, 2006

**WATER HEATER AND PLUMBING
IMPROVEMENTS
CANNON HEALTH BUILDING**

**DEPARTMENT OF HEALTH
SALT LAKE CITY, UTAH**

DFCM Project Number 06140390

**Spectrum Engineers
175 South Main, Suite 300
Salt Lake City, Utah 84111 - 1953**

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Current copies of the following documents are hereby made part of these contract documents by reference. These documents are available on the DFCM web site at <http://dfcm.utah.gov> or are available upon request from DFCM:

DFCM General Conditions dated May 25, 2005

DFCM Application and Certificate for Payment dated May 25, 2005

Technical Specifications:

Drawings:

The Agreement and General Conditions dated May 25, 2005 have been updated from versions that were formally adopted and in use prior to this date. The changes made to the General Conditions are identified in a document entitled Revisions to General Conditions that is available on DFCM's web site at <http://dfcm.utah.gov>

INVITATION TO BID

ONLY FIRMS PRE-QUALIFIED DURING STAGE I OF THE RFS ARE ALLOWED TO BID ON THIS PROJECT

The State of Utah - Division of Facilities Construction and Management (DFCM) is requesting bids for the construction of the following project:

WATER HEATER AND PLUMBING IMPROVEMENTS - CANNON HEALTH BUILDING
DEPARTMENT OF HEALTH – SALT LAKE CITY, UTAH
DFCM PROJECT NO: 06140390

Project Description: Plumbing improvements will consist of replacing the facility's main water heater which is located in the rooftop penthouse. Also included in this project is replacement of the galvanized domestic water supply piping with copper piping throughout the building, along with installation of ADA compliant padding on the supply and waste piping under the counters in all restrooms. This building is open 5 days a week (Monday – Friday) primarily 8:00 AM to 5:00 PM. It will be necessary to perform some of this project work after hours. Once work begins, all interruptions in service to any portion of the facility will be scheduled in advance. Construction Cost Estimate: \$397,000.00.

<u>FIRM NAME</u>	<u>POINT OF CONTACT</u>	<u>PHONE</u>	<u>FAX</u>
A.H. Palmer	Val Palmer	(435) 752-4814	(435) 752-6991
Alternative Mechanical Contractors	Ron White	(801) 261-8523	(801) 261-8561
Envision Mechanical, Inc	Ray Squier	(801) 731-8060	(801) 731-8070
KOH Mechanical Contractors	Larry Hansen	(801) 254-7013	(801) 254-6374
Ralph Tye and Sons, Inc.	Doug Tye	(801) 262-9900	(801) 262-1391
S.R. Mechanical, Inc.	Steven Roberts	(435) 529-7492	(435) 529-7851
Tod R. Packer Heating & AC	Tod R. Packer	(801) 968-2255	(801) 849-1314

The bid documents will be available at 8:00 AM on Wednesday, November 8, 2006 electronic format distributed on CDs from DFCM at 4110 State Office Building, Salt Lake City, Utah 84114, telephone (801)538-3018 and on the DFCM web page at <http://dfcm.utah.gov>. For questions regarding this project, please contact Brent Lloyd, Project Manager, DFCM, at (801)538-3471. No others are to be contacted regarding this project. A **MANDATORY** pre-bid meeting and site visit will be held at 1:00 PM on Tuesday, November 14, 2006 at the Cannon Health Building, 288 North 1460 West, Salt Lake City, Utah. All pre-qualified prime contractors wishing to bid on this project must attend this meeting.

Bids must be submitted by 2:30 PM on Tuesday, November 21, 2006 to DFCM, 4110 State Office Building, Salt Lake City, Utah 84114. Bids will be opened and read aloud in the DFCM Conference Room, 4110 State Office Building, Salt Lake City, Utah. Note: Bids must be received at 4110 State Office Building by the specified time. The contractor shall comply with and require all of its subcontractors to comply with the license laws as required by the State of Utah.

A bid bond in the amount of five percent (5%) of the bid amount, made payable to the Division of Facilities Construction and Management on DFCM's bid bond form, shall accompany the bid.

The Division of Facilities Construction & Management reserves the right to reject any or all bids or to waive any formality or technicality in any bid in the interest of the State.

DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT
MARLA WORKMAN, CONTRACT COORDINATOR
4110 State Office Bldg., Salt Lake City, Utah 84114

STAGE II - MULTI-STEP BIDDING PROCESS

ONLY FIRMS PRE-QUALIFIED DURING STAGE I OF THE RFS ARE ALLOWED TO BID ON THIS PROJECT

1. Invitational Bid Procedures

The following is an overview of the invitational bid process. More detailed information is contained throughout the document. Contractors are responsible for reading and complying with all information contained in this document.

Notification: DFCM will notify each registered pre-qualified firm (via fax or e-mail) when a project is ready for Construction Services and invite them to bid on the project.

Description of Work: A description of work or plans/specifications will be given to each contractor. If required, the plans and specifications will be available on the DFCM web page at <http://dfcm.utah.gov> and on CDs from DFCM, at 4110 State Office Building, Salt Lake City, Utah 84114.

Schedule: The Stage II Schedule shows critical dates including the mandatory pre-bid site meeting (if required), the question and answer period, the bid submittal deadline, the subcontractor list submittal deadline, etc. Contractors are responsible for meeting all deadlines shown on the schedule.

Mandatory Pre-Bid Site Meeting: If a firm fails to attend a pre-bid site meeting labeled “Mandatory” they will not be allowed to bid on the project. At the mandatory meeting, contractors may have an opportunity to inspect the site, receive additional instructions and ask questions about project. The schedule contains information on the date, time, and place of the mandatory pre-bid site meeting.

Written Questions: All questions must be in writing and directed to DFCM’s project manager assigned to this project. No others are to be contacted regarding this project. The schedule contains information on the deadline for submitting questions.

Addendum: All clarifications from DFCM will be in writing and issued as an addendum to the RFS. Addenda will be posted on DFCM’s web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda may result in disqualification from bidding.

Submitting Bids: Bids must be submitted to DFCM 4110 State Office Building, Salt Lake City, Utah 84114 by the deadline indicated on the schedule. Bids submitted after the deadline will not be accepted. Bids will be opened at DFCM on the date, time, and place indicated on the schedule.

Subcontractors List: The firm selected for the project must submit a list of all subcontractors by the deadline indicated on the schedule contained in this document.

Pre-qualified List of Contractors: Contractors shall remain on DFCM’s list of pre-qualified contractors provided: (a) they maintain a performance rating of 4 or greater on each project, (b) they are not suspended for failure to comply with requirements of their contract, (c) the firm has not undergone a significant reorganization involving the loss of key personnel (site superintendents, project managers, owners, etc.) to a degree such that the firm no longer meets the pre-qualification requirements outlined in Stage I, (d) the financial viability of the firm has not significantly changed, and (e) the firm is not otherwise disqualified by DFCM. Note: If a contractor fails to comply with items (a) through (e) above, they may be removed from DFCM’s list of pre-qualified contractors following an evaluation by a review committee. Contractors will be given the opportunity to address the review committee before a decision is made. Pre-qualified contractors are ONLY authorized to bid on projects within the discipline that they were originally pre-qualified under.

2. Drawings and Specifications and Interpretations

Drawings, specifications and other contract documents may be obtained as stated in the Invitation to Bid. If any firm is in doubt as to the meaning or interpretation of any part of the drawings, specifications, scope of work or contract documents, they shall submit, in writing, a request for interpretation to the authorized DFCM representative by the deadline identified in the schedule. Answers to questions and interpretations will be made via addenda issued by DFCM. Neither DFCM or the designer shall be responsible for incorrect information obtained by contractors from sources other than the official drawings/specifications and addenda issued by DFCM.

3. Product Approvals

Where reference is made to one or more proprietary products in the contract documents, but restrictive descriptive materials of one or more manufacturer(s) is referred to in the contract documents, the products of other manufacturers will be accepted, provided they equal or exceed the standards set forth in the drawings and specifications and are compatible with the intent and purpose of the design, subject to the written approval of the Designer. Such written approval must occur prior to the deadline established for the last scheduled addendum to be issued. The Designer's written approval will be included as part of the addendum issued by DFCM. If the descriptive material is not restrictive, the products of other manufacturers specified will be accepted without prior approval provided they are compatible with the intent and purpose of the design as determined by the Designer.

4. Addenda

All clarifications from DFCM will be in writing and issued as an addendum to the RFS. Addenda will be posted on DFCM's web site at <http://dfcm.utah.gov>. Contractors are responsible for obtaining information contained in each addendum from the web site. Addenda issued prior to the submittal deadline shall become part of the bidding process and must be acknowledged on the bid form. Failure to acknowledge addenda shall result in disqualification from bidding. DFCM shall not be responsible for incorrect information obtained by contractors from sources other than official addenda issued by DFCM.

5. Financial Responsibility of Contractors, Subcontractors and Sub-subcontractors

Contractors shall respond promptly to any inquiry in writing by DFCM to any concern of financial responsibility of the Contractor, Subcontractor or Sub-subcontractor. Failure to respond may result in suspension from DFCM's list of pre-qualified contractors.

6. Licensure

The Contractor shall comply with and require all of its Subcontractors to comply with the license laws as required by the State of Utah.

7. Time is of the Essence

Time is of the essence in regard to all the requirements of the contract documents.

8. Bids

Before submitting a bid, each bidder shall carefully examine the contract documents; shall visit the site of the work; shall fully inform themselves as to all existing conditions and limitations; and shall include in the bid the cost of all items required by the contract documents including those added via addenda. If the bidder observes that portions of the contract documents are at variance with applicable laws, building codes, rules, regulations or contain obvious erroneous or uncoordinated information, the bidder shall promptly notify the DFCM Project Manager prior to the bidding deadline. Changes necessary to correct these issues will be made via addenda issued by DFCM.

The bid, bearing original signatures, must be typed or handwritten in ink on the Bid Form provided in the procurement documents and submitted in a sealed envelope at the location specified by the Invitation to Bid prior to the published deadline for the submission of bids.

Bid bond security, in the amount of five percent (5%) of the bid, made payable to the Division of Facilities Construction and Management, shall accompany bid. **THE BID BOND MUST BE ON THE BID BOND FORM PROVIDED IN THE PROCUREMENT DOCUMENTS IN ORDER TO BE CONSIDERED AN ACCEPTABLE BID.**

If the bid bond security is submitted on a form other than DFCM's required bid bond form, and the bid security meets all other legal requirements, the bidder will be allowed to provide an acceptable bid bond by the close of business on the next business day following notification by DFCM of submission of a defective bid bond security. **A cashier's check cannot be used as a substitute for a bid bond.**

9. Listing of Subcontractors

Listing of Subcontractors shall be as summarized in the "Instructions and Subcontractor's List Form", included as part of the contract documents. The subcontractors list shall be delivered to DFCM or faxed to DFCM at (801)538-3677 within 24 hours of the bid opening. Requirements for listing additional subcontractors will be listed in the contract documents.

DFCM retains the right to audit or take other steps necessary to confirm compliance with requirements for the listing and changing of subcontractors. Any contractor who is found to not be in compliance with these requirements may be suspended from DFCM's list of pre-qualified contractors.

10. Contract and Bond

The Contractor's Agreement will be in the form provided in this document. The duration of the contract shall be for the time indicated by the project completion deadline shown on the schedule. The successful bidder, simultaneously with the execution of the Contractor's Agreement, will be required to furnish a performance bond and a payment bond, both bearing original signatures, upon the forms provided in the procurement documents. The performance and payment bonds shall be for an amount equal to one hundred percent (100%) of the Contract Sum and secured from a company that meets the requirements specified in the requisite forms. Any bonding requirements for Subcontractors will be specified in the Supplementary General Conditions.

11. Award of Contract

The Contract will be awarded as soon as possible to the lowest, responsive and responsible bidder, based on the lowest combination of base bid and acceptable prioritized alternates, provided the bid is reasonable, is in the interests of DFCM to accept and after applying the Utah Preference Laws in U.C.A. Title 63, Chapter 56. DFCM reserves the right to waive any technicalities or formalities in any bid or in the bidding. Alternates will be accepted on a prioritized basis with Alternate 1 being highest priority, Alternate 2 having second priority, etc. Alternates will be selected in prioritized order up to the construction cost estimate.

12. Right to Reject Bids

DFCM reserves the right to reject any or all Bids.

13. Withdrawal of Bids

Bids may be withdrawn on written request received from bidders within 24 hours after the bid opening if the contractor has made an error in preparing the bid.

14. DFCM Contractor Performance Rating

As a contractor completes each project, DFCM will evaluate project performance based on the enclosed “DFCM Contractor Performance Rating” form. The ratings issued on this project may affect the firm’s “pre-qualified” status and their ability to obtain future work with DFCM.

**Division of Facilities Construction and Management****Stage II
PROJECT SCHEDULE**

PROJECT NAME: WATER HEATER AND PLUMBING IMPROVEMENTS CANNON HEALTH BUILDING DEPARTMENT OF HEALTH – SALT LAKE CITY, UTAH DFCM PROJECT # 06140390				
Event	Day	Date	Time	Place
Stage II Bidding Documents Available	Wednesday	November 8, 2006	8:00 AM	DFCM 4110 State Office Bldg SLC, UT and DFCM web site*
Mandatory Pre-bid Site Meeting	Tuesday	November 14, 2006	1:00 PM	Cannon Health Building 288 North 1460 West SLC, UT
Deadline for Submitting Questions	Wednesday	November 15, 2006	4:00 PM	Brent Lloyd - DFCM 4110 State Office Bldg SLC, UT
Final Addendum Issued	Thursday	November 16, 2006	4:00 PM	DFCM web site*
Prime Contractors Turn in Bid and Bid Bond / Bid Opening in DFCM Conference Room	Tuesday	November 21, 2006	2:30 PM	DFCM 4110 State Office Bldg SLC, UT
Subcontractors List Due	Wednesday	November 22, 2006	2:30 PM	DFCM 4110 State Office Bldg SLC, UT Fax: 801-538-3677
Project Completion Deadline	120 Calendar Days from Notice to Proceed			

* DFCM's web site address is <http://dfcm.utah.gov>

**Division of Facilities Construction and Management****DFCM****BID FORM**

NAME OF BIDDER _____ DATE _____

To the Division of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

The undersigned, responsive to the "Notice to Contractors" and in accordance with the Request for Bids for the **WATER HEATER AND PLUMBING IMPROVEMENTS - CANNON HEALTH BUILDING - DEPARTMENT OF HEALTH – SALT LAKE CITY, UTAH - DFCM PROJECT NO. 06140390** and having examined the Contract Documents and the site of the proposed Work and being familiar with all of the conditions surrounding the construction of the proposed Project, including the availability of labor, hereby proposes to furnish all labor, materials and supplies as required for the Work in accordance with the Contract Documents as specified and within the time set forth and at the price stated below. This price is to cover all expenses incurred in performing the Work required under the Contract Documents of which this bid is a part:

I/We acknowledge receipt of the following Addenda: _____

For all work shown on the Drawings and described in the Specifications and Contract Documents, I/we agree to perform for the sum of:

_____ DOLLARS (\$_____)
(In case of discrepancy, written amount shall govern)

I/We guarantee that the Work will be Substantially Complete within **120 calendar days** after the date of the Notice to Proceed, should I/we be the successful bidder, and agree to pay liquidated damages in the amount of **\$250.00** per day for each day after expiration of the Contract Time as stated in Article 3 of the Contractor's Agreement.

This bid shall be good for 45 days after bid opening.

Enclosed is a 5% bid bond, as required, in the sum of _____

The undersigned Contractor's License Number for Utah is _____.

BID FORM
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Upon receipt of notice of award of this bid, the undersigned agrees to execute the contract within ten (10) days, unless a shorter time is specified in Contract Documents, and deliver acceptable Performance and Payment bonds in the prescribed form in the amount of 100% of the Contract Sum for faithful performance of the contract. The Bid Bond attached, in the amount not less than five percent (5%) of the above bid sum, shall become the property of the Division of Facilities Construction and Management as liquidated damages for delay and additional expense caused thereby in the event that the contract is not executed and/or acceptable 100% Performance and Payment bonds are not delivered within time set forth.

Type of Organization: _____
(Corporation, Partnership, Individual, etc.)

Any request and information related to Utah Preference Laws:

Respectfully submitted,

Name of Bidder

ADDRESS:

Authorized Signature

BID BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed, (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the STATE OF UTAH, hereinafter referred to as the "Obligee," in the amount of \$ _____ (5% of the accompanying bid), being the sum of this Bond to which payment the Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that whereas the Principal has submitted to Obligee the accompanying bid incorporated by reference herein, dated as shown, to enter into a contract in writing for the _____ Project.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the said principal does not execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the principal, then the sum of the amount stated above will be forfeited to the State of Utah as liquidated damages and not as a penalty; if the said principal shall execute a contract and give bond to be approved by the Obligee for the faithful performance thereof within ten (10) days after being notified in writing of such contract to the Principal, then this obligation shall be null and void. It is expressly understood and agreed that the liability of the Surety for any and all defaults of the Principal hereunder shall be the full penal sum of this Bond. The Surety, for value received, hereby stipulates and agrees that obligations of the Surety under this Bond shall be for a term of sixty (60) days from actual date of the bid opening.

PROVIDED, HOWEVER, that this Bond is executed pursuant to provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the above bounden parties have executed this instrument under their several seals on the date indicated below, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

DATED this _____ day of _____, 20_____.

Principal's name and address (if other than a corporation):

By: _____

Title: _____

Principal's name and address (if a corporation):

By: _____

Title: _____
(Affix Corporate Seal)

Surety's name and address:

STATE OF _____)
COUNTY OF _____) ss.

By: _____
Attorney-in-Fact (Affix Corporate Seal)

On this ____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.
My Commission Expires: _____
Resides at: _____

Agency: _____
Agent: _____
Address: _____
Phone: _____

NOTARY PUBLIC

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and Management****INSTRUCTION AND SUBCONTRACTORS LIST FORM**

The three low bidders, as well as all other bidders that desire to be considered, are required by law to submit to DFCM within 24 hours of bid opening a list of **ALL** first-tier subcontractors, including the subcontractor's name, bid amount and other information required by Building Board Rule and as stated in these Contract Documents, on the following basis:

PROJECTS UNDER \$500,000 - ALL SUBS \$20,000 OR OVER MUST BE LISTED
PROJECTS \$500,000 OR MORE - ALL SUBS \$35,000 OR OVER MUST BE LISTED

- Any additional subcontractors identified in the bid documents shall also be listed.
- The DFCM Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law.
- List subcontractors for base bid as well as the impact on the list that the selection of any alternate may have.
- Bidder may not list more than one subcontractor to perform the same work.
- Bidder must list "Self" if performing work itself.

LICENSURE:

The subcontractor's name, the type of work, the subcontractor's bid amount, and the subcontractor's license number as issued by DOPL, if such license is required under Utah Law, shall be listed. Bidder shall certify that all subcontractors, required to be licensed, are licensed as required by State law. A subcontractor includes a trade contractor or specialty contractor and does not include suppliers who provide only materials, equipment, or supplies to a contractor or subcontractor.

BIDDER LISTING 'SELF' AS PERFORMING THE WORK:

Any bidder that is properly licensed for the particular work and intends to perform that work itself in lieu of a subcontractor that would otherwise be required to be on the subcontractor list, must insert the term 'Self' for that category on the subcontractor list form. Any listing of 'Self' on the sublist form shall also include the amount allocated for that work.

'SPECIAL EXCEPTION':

A bidder may list 'Special Exception' in place of a subcontractor when the bidder intends to obtain a subcontractor to perform the work at a later date because the bidder was unable to obtain a qualified or reasonable bid under the provisions of U.C.A. Section 63A-5-208(4). The bidder shall insert the term 'Special Exception' for that category of work, and shall provide documentation with the subcontractor list describing the bidder's efforts to obtain a bid of a qualified subcontractor at a reasonable cost and why the bidder was unable to obtain a qualified subcontractor bid. The Director must find that the bidder complied in good faith with State law requirements for any 'Special Exception' designation, in order for the bid to be considered. If awarded the contract, the Director shall supervise the bidder's efforts to obtain a qualified subcontractor bid. The amount of the awarded contract may not be adjusted to reflect the actual amount of the subcontractor's bid. Any listing of 'Special Exception' on the sublist form shall also include amount allocated for that work.

INSTRUCTIONS AND SUBCONTRACTORS LIST FORM

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GROUND FOR DISQUALIFICATION:

The Director may not consider any bid submitted by a bidder if the bidder fails to submit a subcontractor list meeting the requirements of State law. Director may withhold awarding the contract to a particular bidder if one or more of the proposed subcontractors are considered by the Director to be unqualified to do the Work or for such other reason in the best interest of the State of Utah. Notwithstanding any other provision in these instructions, if there is a good faith error on the sublist form, at the sole discretion of the Director, the Director may provide notice to the contractor and the contractor shall have 24 hours to submit the correction to the Director. If such correction is submitted timely, then the sublist requirements shall be considered met.

CHANGES OF SUBCONTRACTORS SPECIFICALLY IDENTIFIED ON SUBLIST FORM:

Subsequent to twenty-four hours after the bid opening, the contractor may change its listed subcontractors only after receiving written permission from the Director based on complying with all of the following criteria.

- (1) The contractor has established in writing that the change is in the best interest of the State and that the contractor establishes an appropriate reason for the change, which may include, but not is not limited to, the following reasons: the original subcontractor has failed to perform, or is not qualified or capable of performing, and/or the subcontractor has requested in writing to be released.
- (2) The circumstances related to the request for the change do not indicate any bad faith in the original listing of the subcontractors.
- (3) Any requirement set forth by the Director to ensure that the process used to select a new subcontractor does not give rise to bid shopping.
- (4) Any increase in the cost of the subject subcontractor work is borne by the contractor.
- (5) Any decrease in the cost of the subject subcontractor work shall result in a deductive change order being issued for the contract for such decreased amount.
- (6) The Director will give substantial weight to whether the subcontractor has consented in writing to being removed unless the Contractor establishes that the subcontractor is not qualified for the work.

EXAMPLE:

Example of a list where there are only four subcontractors:

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #
ELECTRICAL	ABCD Electric Inc.	\$350,000.00	123456789000
LANDSCAPING	"Self"	300,000.00	123456789000
CONCRETE (ALTERNATE #1)	XYZ Concrete Inc	298,000.00	987654321000
MECHANICAL	"Special Exception" (attach documentation)	Fixed at: 350,000.00	(TO BE PROVIDED AFTER OBTAINING SUBCONTRACTOR)

**PURSUANT TO STATE LAW - SUBCONTRACTOR BID AMOUNTS CONTAINED IN THIS
SUBCONTRACTOR LIST SHALL NOT BE DISCLOSED UNTIL THE CONTRACT HAS BEEN AWARDED.**

**Division of Facilities Construction and Management****SUBCONTRACTORS LIST
FAX TO 801-538-3677****PROJECT TITLE:** _____**Caution:** You must read and comply fully with instructions.

TYPE OF WORK	SUBCONTRACTOR, "SELF" OR "SPECIAL EXCEPTION"	SUBCONTRACTOR BID AMOUNT	CONT. LICENSE #

We certify that:

1. This list includes all subcontractors as required by the instructions, including those related to the base bid as well as any alternates.
2. We have listed "Self" or "Special Exception" in accordance with the instructions.
3. All subcontractors are appropriately licensed as required by State law.

FIRM: _____

DATE: _____

SIGNED BY: _____

NOTICE: FAILURE TO SUBMIT THIS FORM, PROPERLY COMPLETED AND SIGNED, AS REQUIRED IN THESE CONTRACT DOCUMENTS, SHALL BE GROUNDS FOR DFCMS REFUSAL TO ENTER INTO A WRITTEN CONTRACT WITH BIDDER. ACTION MAY BE TAKEN AGAINST BIDDERS BID BOND AS DEEMED APPROPRIATE BY DFCM. ATTACH A SECOND PAGE IF NECESSARY.

FUGITIVE DUST PLAN

The Contractor will fill out the form and file the original with the Division of Air Quality and a copy of the form with the Division of Facilities Construction & Management, prior to the issuance of any notice to proceed.

The Contractor will be fully responsible for compliance with the Fugitive Dust Control Plan, including the adequacy of the plan, any damages, fines, liability, and penalty or other action that results from noncompliance.

Utah Division of Air Quality

April 20, 1999

**GUIDANCE THAT MUST BE CONSIDERED IN DEVELOPING AND SUBMITTING A
DUST CONTROL PLAN FOR COMPLIANCE WITH R307-309-3, 4, 5, 6, 7**

Source Information:

1. Name of your operation (source): provide a name if the source is a construction site.
2. Address or location of your operation or construction site.
3. UTM coordinates or Longitude/Latitude of stationary emission points at your operation.
4. Lengths of the project, if temporary (time period).
5. Description of process (include all sources of dust and fugitive dust). Please, if necessary, use additional sheets of paper for this description. Be sure to mark it as an attachment.
6. Type of material processed or disturbed.
7. Amount of material processed (tons per year, tons per month, lbs./hr., and applicable units).

8. Destination of product (where will the material produced be used or transported, be specific, provide address or specific location), information needed for temporary relocation applicants.
9. Identify the individual who is responsible for the implementation and maintenance of fugitive dust control measures. List name(s), position(s) and telephone number(s).
10. List, and attach copies of any contract lease, liability agreement with other companies that may, or will, be responsible for dust control on site or on the project.

Description of Fugitive Dust Emission Activities
(Things to consider in addressing fugitive dust control strategies.)

1. Type of activities (drilling and blasting, road construction, development construction, earth moving and excavation, handling and hauling materials, cleaning and leveling, etc).
2. List type of equipment generating the fugitive dust.
3. Diagram the location of each activity or piece of equipment on site. Please attach the diagram.
4. Provide pictures or drawings of each activity. Include a drawing of the unpaved/paved road network used to move loads “on” and “off” property.
5. Vehicle miles travels on unpaved roads associated with the activity (average speed).
6. Type of dust emitted at each source (coal, cement, sand, soil, clay, dust, etc.)
7. Estimate the size of the release area at which the activity occurs (square miles). For haul or dirt roads include total miles of road in use during the activity.

Description of Fugitive Dust Emission Controls on Site

Control strategies must be designed to meet 20% opacity or less on site (a lesser opacity may be defined by Approval Order conditions or federal requirements such as NSPS), and control strategies must prevent exceeding 10% opacity from fugitive dust at the property boundary (site boundary) for compliance with R307-309-3.

1. Types of ongoing emission controls proposed for each activity, each piece of equipment, and haul roads.
2. Types of additional dust controls proposed for bare, exposed surfaces (chemical stabilization, synthetic cover, wind breaks, vegetative cover, etc).
3. Method of application of dust suppressant.
4. Frequency of application of dust suppressant.
5. Explain what triggers the use of a special control measure other than routine measures already in place, such as covered loads or measures covered by a permit condition (increase in opacity, high winds, citizen complaints, dry conditions, etc).
6. Explain in detail what control strategies/measures will be implemented off-hours, i.e., Saturdays/Sundays/Holidays, as well as 6 PM to 6 AM each day.

Description of Fugitive Dust Control Off-site

Prevent, to the maximum extent possible, deposition of materials, which may create fugitive dust on public and private paved roads in compliance with R307-309-5, 6, 7.

1. Types of emission controls initiated by your operation that are in place “off” property (application of water, covered loads, sweeping roads, vehicle cleaning, etc.).

2. Proposed remedial controls that will be initiated promptly if materials, which may create fugitive dust, are deposited on public and private paved roads.

Submit the Dust Control Plan to:

Executive Secretary
Utah Air Quality Board
POB 144820
15 North 1950 West
Salt Lake City, Utah 84114-4820

Phone: (801) 536-4000
FAX: (801) 536-4099

Fugitive Dust Control Plan Violation Report

When a source is found in violation of R307-309-3 or in violation of the Fugitive Dust Control Plan, the source must submit a report to the Executive Secretary within 15 days after receiving a Notice of Violation. The report must include the following information:

1. Name and address of dust source.
2. Time and duration of dust episode.
3. Meteorological conditions during the dust episode.
4. Total number and type of fugitive dust activities and dust producing equipment within each operation boundary. If no change has occurred from the existing dust control plan, the source should state that the activity/equipment is the same.
5. Fugitive dust activities or dust producing equipment that caused a violation of R-307-309-3 or the source's dust control plan.
6. Reasons for failing to control dust from the dust generating activity or equipment.
7. New and/or additional fugitive dust control strategies necessary to achieve compliance with R307-309-3, 4, 5, 6, or 7.
8. If it can not be demonstrated that the current approved Dust Control Plan can result in compliance with R307-309-3 through 7, the Dust Control Plan must be revised so as to demonstrate compliance with 307-309-3 through 7. Within 30 days of receiving a fugitive dust Notice of Violation, the source must submit the revised Plan to the Executive Secretary for review and approval.

Submit the Dust Control Plan to:

Executive Secretary	Phone: (801) 536-4000
Utah Air Quality Board	FAX: (801) 536-4099
POB 144820	
15 North 1950 West	
Salt Lake City, Utah 84114-4820	

Attachments: DFCM Form FDR R-307-309, Rule 307-309

Page 7 of 7

CONTRACTOR'S AGREEMENT

FOR:

THIS CONTRACTOR'S AGREEMENT, made and entered into this ____ day of _____, 20__, by and between the DIVISION OF FACILITIES CONSTRUCTION AND MANAGEMENT, hereinafter referred to as "DFCM", and _____, incorporated in the State of _____ and authorized to do business in the State of Utah, hereinafter referred to as "Contractor", whose address is _____.

WITNESSETH: WHEREAS, DFCM intends to have Work performed at _____
_____.

WHEREAS, Contractor agrees to perform the Work for the sum stated herein.

NOW, THEREFORE, DFCM and Contractor for the consideration provided in this Contractor's Agreement, agree as follows:

ARTICLE 1. SCOPE OF WORK. The Work to be performed shall be in accordance with the Contract Documents prepared by _____ and entitled "_____
_____."

The DFCM General Conditions ("General Conditions") dated May 25, 2005 on file at the office of DFCM and available on the DFCM website, are hereby incorporated by reference as part of this Agreement and are included in the specifications for this Project. All terms used in this Contractor's Agreement shall be as defined in the Contract Documents, and in particular, the General Conditions.

The Contractor Agrees to furnish labor, materials and equipment to complete the Work as required in the Contract Documents which are hereby incorporated by reference. It is understood and agreed by the parties hereto that all Work shall be performed as required in the Contract Documents and shall be subject to inspection and approval of DFCM or its authorized representative. The relationship of the Contractor to the DFCM hereunder is that of an independent Contractor.

ARTICLE 2. CONTRACT SUM. The DFCM agrees to pay and the Contractor agrees to accept in full performance of this Contractor's Agreement, the sum of _____ DOLLARS AND NO CENTS (\$_____.00), which is the base bid, and which sum also includes the cost of a 100%

CONTRACTOR'S AGREEMENT
PAGE NO. 2

Performance Bond and a 100% Payment Bond as well as all insurance requirements of the Contractor. Said bonds have already been posted by the Contractor pursuant to State law. The required proof of insurance certificates have been delivered to DFCM in accordance with the General Conditions before the execution of this Contractor's Agreement.

ARTICLE 3. TIME OF COMPLETION AND DELAY REMEDY. The Work shall be Substantially Complete within _____ (____) calendar days after the date of the Notice to Proceed. Contractor agrees to pay liquidated damages in the amount of \$_____ per day for each day after expiration of the Contract Time until the Contractor achieves Substantial Completion in accordance with the Contract Documents, if Contractor's delay makes the damages applicable. The provision for liquidated damages is: (a) to compensate the DFCM for delay only; (b) is provided for herein because actual damages can not be readily ascertained at the time of execution of this Contractor's Agreement; (c) is not a penalty; and (d) shall not prevent the DFCM from maintaining Claims for other non-delay damages, such as costs to complete or remedy defective Work.

No action shall be maintained by the Contractor, including its or Subcontractor or suppliers at any tier, against the DFCM or State of Utah for damages or other claims due to losses attributable to hindrances or delays from any cause whatsoever, including acts and omissions of the DFCM or its officers, employees or agents, except as expressly provided in the General Conditions. The Contractor may receive a written extension of time, signed by the DFCM, in which to complete the Work under this Contractor's Agreement in accordance with the General Conditions.

ARTICLE 4. CONTRACT DOCUMENTS. The Contract Documents consist of this Contractor's Agreement, the Conditions of the Contract (DFCM General Conditions, Supplementary and other Conditions), the Drawings, Specifications, Addenda and Modifications. The Contract Documents shall also include the bidding documents, including the Notice to Contractors, Instructions to Bidders/Proposers and the Bid/Proposal, to the extent not in conflict therewith and other documents and oral presentations that are documented as an attachment to the contract.

All such documents are hereby incorporated by reference herein. Any reference in this Contractor's Agreement to certain provisions of the Contract Documents shall in no way be construed as to lessen the importance or applicability of any other provisions of the Contract Documents.

ARTICLE 5. PAYMENT. The DFCM agrees to pay the Contractor from time to time as the Work progresses, but not more than once each month after the date of Notice to Proceed, and only upon Certificate of the A/E for Work performed during the preceding calendar month, ninety-five percent (95%) of the value of the labor performed and ninety-five percent (95%) of the value of materials furnished in place or on the site. The Contractor agrees to furnish to the DFCM invoices for materials purchased and on the site but not installed, for which the

CONTRACTOR'S AGREEMENT
PAGE NO. 3

Contractor requests payment and agrees to safeguard and protect such equipment or materials and is responsible for safekeeping thereof and if such be stolen, lost or destroyed, to replace same.

Such evidence of labor performed and materials furnished as the DFCM may reasonably require shall be supplied by the Contractor at the time of request for Certificate of Payment on account. Materials for which payment has been made cannot be removed from the job site without DFCM's written approval. Five percent (5%) of the earned amount shall be retained from each monthly payment. The retainage, including any additional retainage imposed and the release of any retainage, shall be in accordance with UCA 13-8-5 as amended. Contractor shall also comply with the requirements of UCA 13-8-5, including restrictions of retainage regarding subcontractors and the distribution of interest earned on the retention proceeds. The DFCM shall not be responsible for enforcing the Contractor's obligations under State law in fulfilling the retention law requirements with subcontractors at any tier.

ARTICLE 6. INDEBTEDNESS. Before final payment is made, the Contractor must submit evidence satisfactory to the DFCM that all payrolls, materials bills, subcontracts at any tier and outstanding indebtedness in connection with the Work have been properly paid. Final Payment will be made after receipt of said evidence, final acceptance of the Work by the DFCM as well as compliance with the applicable provisions of the General Conditions.

Contractor shall respond immediately to any inquiry in writing by DFCM as to any concern of financial responsibility and DFCM reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third parties prior to any payment by DFCM to Contractor.

ARTICLE 7. ADDITIONAL WORK. It is understood and agreed by the parties hereto that no money will be paid to the Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. The DFCM specifically reserves the right to modify or amend this Contractor's Agreement and the total sum due hereunder either by enlarging or restricting the scope of the Work.

ARTICLE 8. INSPECTIONS. The Work shall be inspected for acceptance in accordance with the General Conditions.

ARTICLE 9. DISPUTES. Any dispute, PRE or Claim between the parties shall be subject to the provisions of Article 7 of the General Conditions. DFCM reserves all rights to pursue its rights and remedies as provided in the General Conditions.

ARTICLE 10. TERMINATION, SUSPENSION OR ABANDONMENT. This Contractor's Agreement may be terminated, suspended or abandoned in accordance with the General Conditions.

ARTICLE 11. DFCM'S RIGHT TO WITHHOLD CERTAIN AMOUNT AND MAKE USE THEREOF. The DFCM may withhold from payment to the Contractor such amount as, in DFCM's judgment, may be necessary to pay just claims against the Contractor or Subcontractor at any tier for labor and services rendered and materials furnished in and about the Work. The DFCM may apply such withheld amounts for the payment of such claims in DFCM's discretion. In so doing, the DFCM shall be deemed the agent of Contractor and payment so made by the DFCM shall be considered as payment made under this Contractor's Agreement by the DFCM to the Contractor. DFCM shall not be liable to the Contractor for any such payment made in good faith. Such withholdings and payments may be made without prior approval of the Contractor and may be also be prior to any determination as a result of any dispute, PRE, Claim or litigation.

ARTICLE 12. INDEMNIFICATION. The Contractor shall comply with the indemnification provisions of the General Conditions.

ARTICLE 13. SUCCESSORS AND ASSIGNMENT OF CONTRACT. The DFCM and Contractor, respectively bind themselves, their partners, successors, assigns and legal representatives to the other party to this Agreement, and to partners, successors, assigns and legal representatives of such other party with respect to all covenants, provisions, rights and responsibilities of this Contractor's Agreement. The Contractor shall not assign this Contractor's Agreement without the prior written consent of the DFCM, nor shall the Contractor assign any moneys due or to become due as well as any rights under this Contractor's Agreement, without prior written consent of the DFCM.

ARTICLE 14. RELATIONSHIP OF THE PARTIES. The Contractor accepts the relationship of trust and confidence established by this Contractor's Agreement and covenants with the DFCM to cooperate with the DFCM and A/E and use the Contractor's best skill, efforts and judgment in furthering the interest of the DFCM; to furnish efficient business administration and supervision; to make best efforts to furnish at all times an adequate supply of workers and materials; and to perform the Work in the best and most expeditious and economic manner consistent with the interests of the DFCM.

ARTICLE 15. AUTHORITY TO EXECUTE AND PERFORM AGREEMENT. Contractor and DFCM each represent that the execution of this Contractor's Agreement and the performance thereunder is within their respective duly authorized powers.

ARTICLE 16. ATTORNEY FEES AND COSTS. Except as otherwise provided in the dispute resolution provisions of the General Conditions, the prevailing party shall be entitled to reasonable attorney fees and costs incurred in any action in the District Court and/or appellate body to enforce this Contractor's Agreement or recover damages or any other action as a result of a breach thereof.

CONTRACTOR'S AGREEMENT
PAGE NO. 5

IN WITNESS WHEREOF, the parties hereto have executed this Contractor's Agreement on the day and year stated hereinabove.

CONTRACTOR: _____

Signature Date

Title: _____

State of _____)
County of _____)

Please type/print name clearly

On this ____ day of _____, 20____, personally appeared before me, _____, whose identity is personally known to me (or proved to me on the basis of satisfactory evidence) and who by me duly sworn (or affirmed), did say that he (she) is the _____ (title or office) of the firm and that said document was signed by him (her) in behalf of said firm.

(SEAL)

Notary Public

My Commission Expires _____

APPROVED AS TO AVAILABILITY
OF FUNDS:

Financial Manager, Date
Division of Facilities Construction
and Management

**DIVISION OF FACILITIES
CONSTRUCTION AND MANAGEMENT**

Manager - Date
Capital _____

APPROVED AS TO FORM:
ATTORNEY GENERAL
May 25, 2005
By: Alan S. Bachman
Asst Attorney General

APPROVED FOR EXPENDITURE:

Division of Finance Date

PERFORMANCE BOND
(Title 63, Chapter 56, U. C. A. 1953, as Amended)

That _____ hereinafter referred to as the "Principal" and _____, a corporation organized and existing under the laws of the State of _____, with its principal office in the City of _____ and authorized to transact business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah, hereinafter referred to as the "Obligee," in the amount of _____ DOLLARS (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____, for the approximate sum of _____ Dollars (\$ _____), which Contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall faithfully perform the Contract in accordance with the Contract Documents including, but not limited to, the Plans, Specifications and conditions thereof, the one year performance warranty, and the terms of the Contract as said Contract may be subject to Modifications or changes, then this obligation shall be void; otherwise it shall remain in full force and effect.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the state named herein or the heirs, executors, administrators or successors of the Owner.

The parties agree that the dispute provisions provided in the Contract Documents apply and shall constitute the sole dispute procedures of the parties.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the Provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____
(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____
Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney in-fact of the above-named Surety Company and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

PAYMENT BOND

(Title 63, Chapter 56, U. C. A. 1953, as Amended)

KNOW ALL PERSONS BY THESE PRESENTS:

That _____ hereinafter referred to as the "Principal," and _____, a corporation organized and existing under the laws of the State of _____ authorized to do business in this State and U. S. Department of the Treasury Listed (Circular 570, Companies Holding Certificates of Authority as Acceptable Securities on Federal Bonds and as Acceptable Reinsuring Companies); with its principal office in the City of _____, hereinafter referred to as the "Surety," are held and firmly bound unto the State of Utah hereinafter referred to as the "Obligee," in the amount of _____ Dollars (\$ _____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Obligee, dated the _____ day of _____, 20____, to construct _____ in the County of _____, State of Utah, Project No. _____ for the approximate sum of _____ Dollars (\$ _____), which contract is hereby incorporated by reference herein.

NOW, THEREFORE, the condition of this obligation is such that if the said Principal shall pay all claimants supplying labor or materials to Principal or Principal's Subcontractors in compliance with the provisions of Title 63, Chapter 56, of Utah Code Annotated, 1953, as amended, and in the prosecution of the Work provided for in said Contract, then, this obligation shall be void; otherwise it shall remain in full force and effect.

That said Surety to this Bond, for value received, hereby stipulates and agrees that no changes, extensions of time, alterations or additions to the terms of the Contract or to the Work to be performed thereunder, or the specifications or drawings accompanying same shall in any way affect its obligation on this Bond, and does hereby waive notice of any such changes, extensions of time, alterations or additions to the terms of the Contract or to the Work or to the specifications or drawings and agrees that they shall become part of the Contract Documents.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Title 63, Chapter 56, Utah Code Annotated, 1953, as amended, and all liabilities on this Bond shall be determined in accordance with said provisions to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20____.

WITNESS OR ATTESTATION:

PRINCIPAL:

By: _____
(Seal)

Title: _____

WITNESS OR ATTESTATION:

SURETY:

By: _____
Attorney-in-Fact (Seal)

STATE OF _____)
) ss.
COUNTY OF _____)

On this _____ day of _____, 20____, personally appeared before me _____, whose identity is personally known to me or proved to me on the basis of satisfactory evidence, and who, being by me duly sworn, did say that he/she is the Attorney-in-fact of the above-named Surety Company, and that he/she is duly authorized to execute the same and has complied in all respects with the laws of Utah in reference to becoming sole surety upon bonds, undertakings and obligations, and that he/she acknowledged to me that as Attorney-in-fact executed the same.

Subscribed and sworn to before me this _____ day of _____, 20____.

My commission expires: _____

Resides at: _____

NOTARY PUBLIC

Agency: _____
Agent: _____
Address: _____
Phone: _____

Approved As To Form: May 25, 2005
By Alan S. Bachman, Asst Attorney General

**Division of Facilities Construction and Management****CHANGE ORDER #** _____

CONTRACTOR: _____

AGENCY OR INSTITUTION: _____

PROJECT NAME: _____

PROJECT NUMBER: _____

CONTRACT NUMBER: _____

ARCHITECT: _____

DATE: _____

CONSTRUCTION CHANGE DIRECTIVE NO.	PROPOSAL REQUEST NO.	AMOUNT		DAYS	
		INCREASE	DECREASE	INCREASE	DECREASE

	Amount	Days	Date
ORIGINAL CONTRACT			
TOTAL PREVIOUS CHANGE ORDERS			
TOTAL THIS CHANGE ORDER			
ADJUSTED CONTRACT			

DFCM and Contractor agree that the terms, contract sum, scope of the Work and time specified in this Change Order shall constitute the full accord and satisfaction, and complete adjustment to the Contract and includes all direct and indirect costs and effects related to, incidental to, and/or reasonably implied from such change in the contract terms, sum, scope of the Work and time.

Contractor: _____

Date

Architect/Engineer: _____

Date

Agency or Institution: _____

Date

DFCM: _____

Date

Funding Verification: _____

Date

Page ____ of ____ page(s)

**CERTIFICATE OF SUBSTANTIAL COMPLETION**

PROJECT _____ PROJECT NO: _____

AGENCY/INSTITUTION _____

AREA ACCEPTED _____

The Work performed under the subject Contract has been reviewed on this date and found to be Substantially Completed as defined in the General Conditions; including that the construction is sufficiently completed in accordance with the Contract Documents, as modified by any change orders agreed to by the parties, so that the State of Utah can occupy the Project or specified area of the Project for the use for which it is intended.

The DFCM - (Owner) accepts the Project or specified area of the Project as Substantially Complete and will assume full possession of the Project or specified area of the Project at _____ (time) on _____ (date).

The DFCM accepts the Project for occupancy and agrees to assume full responsibility for maintenance and operation, including utilities and insurance, of the Project subject to the itemized responsibilities and/or exceptions noted below:

The Owner acknowledges receipt of the following closeout and transition materials:

- ☐ Record Drawings ☐ O & M Manuals ☐ Warranty Documents ☐ Completion of Training Requirements

A list of items to be completed or corrected (Punch List) is attached hereto. The failure to include an item on it does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents, including authorized changes thereof. The amount of _____. (Twice the value of the punch list work) shall be retained to assure the completion of the punch list work.

The Contractor shall complete or correct the Work on the list of (Punch List) items appended hereto within _____ calendar days from the above date of issuance of this Certificate. If the list of items is not completed within the time allotted the Owner has the right to be compensated for the delays and/or complete the work with the help of independent contractor at the expense of the retained project funds. If the retained project funds are insufficient to cover the delay/completion damages, the Owner shall be promptly reimbursed for the balance of the funds needed to compensate the Owner.

CONTRACTOR (include name of firm) by: _____
(Signature) DATE

A/E (include name of firm) by: _____
(Signature) DATE

USING INSTITUTION OR AGENCY by: _____
(Signature) DATE

DFCM (Owner) by: _____
(Signature) DATE

4110 State Office Building, Salt Lake City, Utah 84114
telephone 801-538-3018 • facsimile 801-538-3267 • <http://dfcm.utah.gov>

cc: Parties Noted
DFCM, Director

MECHANICAL SPECIFICATIONS INDEX

SECTION 02300	EARTHWORK
SECTION 02668	WATER SERVICE PIPING
SECTION 15010	BASIC MECHANICAL REQUIREMENTS
SECTION 15052	COMMON WORK RESULTS FOR PLUMBING
SECTION 15053	COMMON WORK RESULTS FOR HVAC
SECTION 15061	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
SECTION 15071	MECHANICAL VIBRATION AND SEISMIC CONTROLS
SECTION 15076	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
SECTION 15080	MECHANICAL INSULATION
SECTION 15110	VALVES
SECTION 15123	EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING
SECTION 15126	METERS AND GAGES FOR PLUMBING PIPING
SECTION 15140	DOMESTIC WATER PIPING
SECTION 15145	DOMESTIC WATER PIPING SPECIALTIES
SECTION 15410	PLUMBING FIXTURES
SECTION 15450	POTABLE-WATER STORAGE TANKS
SECTION 15486	FUEL-FIRED WATER HEATERS
SECTION 15855	AIR OUTLETS AND INLETS

SECTION 02300 - EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and backfilling for buildings and structures.
 - 2. Excavating and backfilling for utility trenches.
 - 3. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures.
- B. Related Sections include the following:
 - 1. Divisions 2 and 15 Sections for installing underground mechanical utilities and buried mechanical structures.

1.2 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized

excavation, as well as remedial work directed by Architect, shall be without additional compensation.

- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,090 lbf (125 kN) and stick-crowd force of not less than 18,650 lbf (83 kN); measured according to SAE J-1179.
 - 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp (157-kW) flywheel power and developing a minimum of 48,510-lbf (216-kN) breakout force with a general-purpose bare bucket; measured according to SAE J-732.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume that exceed a standard penetration resistance of 100 blows/2 inches (97 blows/50 mm) when tested by an independent geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

- A. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
 - 1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.

2. Seismographic monitoring during blasting operations.

- B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- C. Preexcavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.4 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM, or a combination of these groups; free of rock or gravel larger than **3 inches (75 mm)** in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 12 percent passing a **No. 200 (0.075-mm)** sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent

passing a **1-1/2-inch (37.5-mm)** sieve and not more than 8 percent passing a **No. 200 (0.075-mm)** sieve.

- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 12 percent passing a **No. 200 (0.075-mm)** sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a **1-inch (25-mm)** sieve and not more than 8 percent passing a **No. 200 (0.075-mm)** sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a **1-1/2-inch (37.5-mm)** sieve and 0 to 5 percent passing a **No. 8 (2.36-mm)** sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a **1-inch (25-mm)** sieve and 0 to 5 percent passing a **No. 4 (4.75-mm)** sieve.
- J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: **157 lbf (700 N)**; ASTM D 4632.
 - 3. Sewn Seam Strength: **142 lbf (630 N)**; ASTM D 4632.
 - 4. Tear Strength: **56 lbf (250 N)**; ASTM D 4533.
 - 5. Puncture Strength: **56 lbf (250 N)**; ASTM D 4833.
 - 6. Apparent Opening Size: **No. 40 (0.425-mm)** sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: **247 lbf (1100 N)**; ASTM D 4632.

3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Low-density, self-compacting, flowable concrete material as follows:
 1. Portland Cement: ASTM C 150, Type I .
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33, 3/4-inch (19-mm) nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869.
 5. Water: ASTM C 94/C 94M.
 6. Air-Entraining Admixture: ASTM C 260.
- B. Produce low-density, controlled low-strength material with the following physical properties:
 1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. (480 to 576 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
 2. Compressive Strength: 80 psi (550 kPa), when tested according to ASTM C 495.
- C. Produce conventional-weight, controlled low-strength material with 80-psi (550-kPa) compressive strength when tested according to ASTM C 495.

2.4 GEOFOAM

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft. (26 kg/cu. m).
- B. Molded-Polystyrene Board Insulation: ASTM C 578, Type I, 0.90 lb/cu. ft. (15 kg/cu. m).
 1. Manufacture molded polystyrene with an inorganic mineral registered with the EPA and suitable for application as a termite deterrent.
- C. Geofoam Connectors: Geofoam manufacturer's multibarbed galvanized steel sheet connectors.

2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils

(0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 2 Section "Site Clearing."
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 2 Section "Site Clearing," during earthwork operations.
- D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches (600 mm) outside of concrete forms other than at footings.
 - b. 12 inches (300 mm) outside of concrete forms at footings.
 - c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - e. 6 inches (150 mm) beneath bottom of concrete slabs on grade.
 - f. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
 - a. 24 inches (600 mm) outside of concrete forms other than at footings.
 - b. 12 inches (300 mm) outside of concrete forms at footings.
 - c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
 - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

- e. 6 inches (150 mm) beneath bottom of concrete slabs on grade.
- f. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 - 1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
 - 1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.6 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to **3 mph (5 km/h)**.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons (13.6 tonnes)**.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of **2500 psi (17.2 MPa)**, may be used when approved by Architect.
1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring and bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches excavated under footings and within **18 inches (450 mm)** of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 3 Section "Cast-in-Place Concrete."
- D. Provide **4-inch- (100-mm-)** thick, concrete-base slab support for piping or conduit less than **30 inches (750 mm)** below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of **4 inches (100 mm)** of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of satisfactory soil, free of particles larger than **1 inch (25 mm)** in any dimension, to a height of **12 inches (300 mm)** over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of **12 inches (300 mm)** over the utility pipe or conduit.
- G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.
- H. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- J. Install warning tape directly above utilities, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

3.11 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.12 GEOFOAM FILL

- A. Place a leveling course of sand, **2 inches (50 mm)** thick, over subgrade. Finish leveling course to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.
1. Place leveling course on subgrades free of mud, frost, snow, or ice.
- B. Install geofoam blocks in layers with abutting edges and ends and with the long dimension of each block at right angles to blocks in each subsequent layer. Offset joints of blocks in successive layers.
- C. Install geofoam connectors at each layer of geofoam to resist horizontal displacement according to geofoam manufacturer's written instructions.
- D. Cover geofoam with separation geotextile before placing overlying soil materials.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **8 inches (200 mm)** in loose depth for material compacted by heavy compaction equipment, and not more than **4 inches (100 mm)** in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches (300 mm)** of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under lawn or unpaved areas, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 1. Lawn or Unpaved Areas: Plus or minus **1 inch (25 mm)**.
 2. Walks: Plus or minus **1 inch (25 mm)**.
 3. Pavements: Plus or minus **1/2 inch (13 mm)**.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least 1 test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than 3 tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least 1 test for each 100 feet (30 m) or less of wall length, but no fewer than 2 tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least 1 test for each 150 feet (46 m) or less of trench length, but no fewer than 2 tests.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
- B. Disposal: Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300

SECTION 02668 - WATER SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes water service piping and appurtenances from the source of potable water to a point 5 feet outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Earthwork" for excavation and backfill required for water service piping and structures.
 - 2. Division 15 Section "Water Distribution Piping" for interior building water piping systems and equipment.Products installed but not furnished under this Section include water meters provided by the utility company to the site, ready for installation.

1.3 SUBMITTALS

- A. Coordination drawings showing pipe sizes, and valves and meter locations and elevations. Include details of underground structures, connections, anchors, and reaction backing. Show other piping in the same trench and clearances from water service piping. Indicate interface and spatial relationship between piping and proximate structures.
- B. Coordination profile drawings showing water service piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe, valves, structures, meter, anchors, and reaction backing. Show types, sizes, materials, and elevations of other utilities crossing water service piping.
- C. Record drawings at project closeout of installed water service piping and products in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying water to the project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends, flange faces, and weld ends.
 3. Set valves in best position for handling. Set gate valves closed to prevent rattling.
- B. Storage: Use the following precautions for valves during storage:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

1.6 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that water service piping may be installed in compliance with the original design and referenced standards.

1.7 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public water main with utility company.
- B. Coordinate with interior water distribution piping.
- C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Gate Valves:
 - a. American Darling Valve; Div. of American Cast Iron Pipe Co.
 - b. Clow Valve Co.; Div. of McWane, Inc.
 - c. Hammond Valve Corp.
 - d. Jenkins Bros.
 - e. Kennedy Valve; Div. of McWane, Inc.
 - f. Milwaukee Valve Co.
 - g. Mueller-Hersey; A Grinnell Co.
 - h. Nibco, Inc.
 - i. Stockham Valve & Fittings, Inc.
 - j. U.S. Pipe & Foundry Co.
 - k. Waterous Co.

2. Bronze Corporation Stops and Valves:
 - a. Ford Meter Box Co., Inc.
 - b. Hays Div.; Romac Industries.
 - c. McDonald, A.Y., Mfg. Co.
 - d. Mueller-Hersey; A Grinnell Co.
3. Drilling Machine Corporation Stops:
 - a. Ford Meter Box Co., Inc.
 - b. Hays Div.; Romac Industries.
 - c. Mueller-Hersey; A Grinnell Co.
4. Tapping Valves:
 - a. Clow Valve Co.; Div. of McWane, Inc.
 - b. Kennedy Valve; Div. of McWane, Inc.
 - c. Mueller-Hersey; A Grinnell Co.
 - d. U.S. Pipe & Foundry Co.
5. Yard Hydrants, Post Type:
 - a. Ancon, Inc.
 - b. Josam Co.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Woodford Mfg. Co.
 - f. Zurn Industries, Inc.; Hydromechanics Div.
6. Yard Hydrants, Sanitary Type:
 - a. Murdock, Inc.
7. Water Meters:
 - a. Badger Meter, Inc.
 - b. Hays Div.; Romac Industries.
 - c. Kent Meters, Inc.
 - d. Mueller-Hersey; A Grinnell Co.
 - e. Rockwell Intl.; Measurement & Flow Control Div.
 - f. Schlumberger Industries; Neptune Water Div.
8. Drains:
 - a. Ancon, Inc.
 - b. Josam Co.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Zurn Industries, Inc.; Hydromechanics Div.
9. Underground Warning Tapes:
 - a. Allen Systems, Inc.; Reef Industries, Inc.
 - b. Brady (W.H.) Co.; Signmark Div.
 - c. Calpico, Inc.
 - d. Carlton Industries, Inc.
 - e. EMED Co., Inc.
 - f. Seton Name Plate Co.

2.2 PIPE AND PIPE FITTINGS, GENERAL

- A. Pipe and pipe fitting materials shall be compatible with each other. Where more than one type of material or product is indicated, selection is Installer's option.
- B. PVC (Polyvinyl Chloride) Pipe 4 Inches and Larger: AWWA C900; Class 150; with bell end and elastomeric gasket, with plain end for cast-iron or ductile-iron fittings, or with plain end for PVC elastomeric gasket fittings.
 - 1. Gaskets: ASTM F 477, elastomeric seal.
 - 2. PVC Couplings and Fittings: AWWA C900, with ASTM F 477 elastomeric seal gaskets.
 - 3. Ductile-Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating; of dimension to match pipe outside diameter.
 - a. Lining: AWWA C104, cement mortar.
 - b. Gaskets: AWWA C111, rubber.
- C. Couplings: Iron body sleeve assembly fabricated to match outside diameters of pipes to be joined.
 - 1. Sleeve: ASTM A 126, Class B, gray iron.
 - 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 - 3. Gaskets: Rubber.
 - 4. Bolts and Nuts: AWWA C111.
 - 5. Finish: Enamel paint.

2.3 VALVES

- A. Nonrising Stem Gate Valves 3 Inches and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psi working pressure, mechanical joint ends.
- B. Rising Stem Gate Valves, 3 Inches and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; cast-iron or ductile-iron body and bonnet, OS&Y, bronze stem, 200-psi working pressure, flanged ends.
- C. Nonrising Stem Gate Valves, 2 Inches and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, nonrising copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable iron handwheel.
- D. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
 - 1. Provide a steel tee-handle operating wrench with each valve box. Wrench shall have tee handle with one pointed end, stem of length to operate valve, and socket fitting valve operating nut.

- E. Curb Stops: Bronze body, ground key plug or ball, and wide tee head, with inlet and outlet to match service piping material.
- F. Service Boxes for Curb Stops: Cast-iron box having telescoping top section of length required for depth of bury of valve and cover having lettering "WATER," and bottom section with base of size to fit over curb stop and barrel approximately 3 inches in diameter.
 - 1. Provide steel tee-handle shut-off rod with each service box. Shut-off rod shall have tee handle with one pointed end, stem of length to operate curb stop, and slotted end fitting curb stop head.
- G. Tapping Sleeve and Tapping Valve: Provide a complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. The sleeve and the valve shall be compatible with the tapping machine to be used.
 - 1. Tapping Sleeve: Cast-iron or ductile-iron 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical joint ends with rubber gaskets or have sealing rings in the sleeve body. Sleeve shall mate with the size and type pipe material being tapped. Outlet flange shall be size required for branch connection.
- H. Service Clamps and Corporation Stops: Provide a complete assembly, including service clamp, corporation stop, and bolts and nuts. The clamp and stop shall be compatible with the drilling machine to be used.
 - 1. Service Clamp: Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.
 - 2. Corporation Stops: Bronze body and ground key plug, with AWWA C800 threaded inlet and outlet to match service piping material.
 - 3. Manifold: Copper with two to four inlets, as required, with ends matching corporation stops, and outlet matching service piping.

2.4 ANCHORAGES

- A. Clamps, Straps, and Washers: ASTM A 506, steel.
- B. Rods: ASTM A 575, steel.
- C. Rod Couplings: ASTM A 197, malleable iron.
- D. Bolts: ASTM A 307, steel.
- E. Cast-Iron Washers: ASTM A 126, gray iron.
- F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.

2.5 YARD HYDRANTS

- A. Yard Hydrants, Post Type: Nonfreeze, post type, 3/4-inch inlet, integral or field installed vacuum breaker with outlet conforming to ASME B1.20.7 for garden hose thread. Hydrants shall be bronze casing, cast-iron or cast-aluminum casing guard, key operated, and tapped drain port in valve housing. Hydrant shall be of length required for installation of inlet valve below frost line. Furnish 2 keys for each hydrant.
- B. Yard Hydrants, Sanitary Type: Nonfreeze, post type, having non-draining chamber for storing water trapped downstream of inlet valve. Hydrants shall have 1-inch inlet, integral or field-installed vacuum breaker with outlet conforming to ASME B1.20.7 for garden hose thread, brass or bronze casing and other parts in contact with water, and shall be handle or key operated. Body of the hydrant shall be of length required for installation of storage chamber below frost line. Furnish 2 keys for each key-operated hydrant.

2.6 VALVE PITS AND METER PIT

- A. Concrete: Portland cement mix, 3000 psi.
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Reinforcement: Steel conforming to the following:
 - 1. Fabric: ASTM A 185, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- C. Ladder: ASTM A 36, steel, or may be polyethylene-encased cast-iron or steel steps.
- D. Manhole: ASTM A 48, Class 35, gray iron, 24-inch minimum diameter traffic frame and cover, of size and weight indicated.
- E. Manhole: ASTM A 536, Grade 60-40-18, ductile iron, 24-inch minimum diameter traffic frame and cover, of size and weight indicated.
- F. Drain: ANSI A112.21.1M, area drain, cast iron, of size indicated. Body shall have anchor flange, light-duty cast-iron grate, and bottom outlet. Drain shall have integral or field-installed bronze ball or clapper-type backwater valve.

2.7 WATER METER

- A. Water meter will be furnished by the utility company.

2.8 IDENTIFICATION

- A. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."

- B. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."
- C. Nonmetallic Piping Label: Engraved plastic laminate label, for installation on the main electrical meter panel; not less than 1 inch by 3 inches, with caption "CAUTION - THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE."

PART 3 - EXECUTION

3.1 PREPARATION OF BURIED PIPE FOUNDATION

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

3.2 INSTALLATION OF PIPE AND PIPE FITTINGS

- A. PVC (Polyvinyl Chloride) Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA M23.
- B. Depth of Cover: Provide minimum cover over piping of 12 inches below average local frost depth or 36 inches below finished grade, whichever is greater.
- C. Water Main Connection: Arrange and pay for tap in water main, of size and in location as indicated, from water utility.
- D. Water Main Connection: Tap water main with size and in location as indicated, in accordance with requirements of water utility.
 - 1. Install tapping sleeve and tapping valve in accordance with manufacturer's installation instructions.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Install gate valve onto tapping sleeve. Comply with AWWA C600. Install valve with stem pointing up and with cast-iron valve box.
 - 4. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water service piping.
 - 5. Install service clamps and corporation stops in size, quantity, and arrangement required by the utility company standards, and in accordance with manufacturer's installation instructions.
 - 6. Install service clamps on pipe to be tapped. Position outlet for corporation stop.

7. Install corporate stops into service clamps. Install valve with stem pointing up and with cast-iron valve box.
 8. Install curb stop in service piping with head pointing up and with cast-iron service box.
 9. Install manifold for multiple taps in water main.
 10. Use drilling machine compatible with service clamp and corporate stop. Drill hole in main. Remove drilling machine and connect water service piping.
- E. Water Service Termination: Terminate water service piping inside building where indicated. Provide line-size gate valve, 3/4-inch valved test tee, and pressure gage. Provide sleeve cast into building wall and watertight sleeve seal.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

3.3 INSTALLATION OF VALVES

- A. General Application: Use mechanical joint end valves for 3-inch and larger buried installation. Use threaded and flanged end valves for installation in pits and inside building. Use bronze corporation stops and valves, with ends compatible to piping, for 2-inch and smaller installation.
- B. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
- C. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's installation instructions. Install buried curb stops with head pointed up and with cast-iron curb box.

3.4 INSTALLATION OF ANCHORAGES

- A. Anchorages: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

3.5 APPLICATION OF PROTECTIVE COATINGS

- A. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.6 INSTALLATION OF HYDRANTS

- A. Install post-type yard hydrants in pavement or with concrete anchor, and provision for drainage into drywell, as indicated.
- B. Install sanitary-type yard hydrants in pavement or with concrete anchor, as indicated.

3.7 INSTALLATION OF VALVE PITS AND WATER METER PIT

- A. Construct of poured-in-place or precast concrete of dimensions indicated, with manhole frame and cover, ladder, and drain. Provide sleeves with waterproof sleeve seals for pipe entry and exit.
- B. Water Meter: Install water meter in accordance with AWWA M6, in meter pit, in location and with support as indicated. Provide 3-valve bypass around meter, full size of water service piping.

3.8 INSTALLATION OF IDENTIFICATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.
- B. Attach nonmetallic piping label permanently to main electrical meter panel.

3.9 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
 - 1. Increase pressure in 50-psi increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

3.10 CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.
 - 2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, use the procedure described in AWWA C651, or as described below:
 - a. Fill the system or part thereof with a water/ chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - b. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - c. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.

- d. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

- B. Prepare reports for all purging and disinfecting activities.

3.11 VALVE SCHEDULE

- A. Nonrising Stem Gate Valves - 4 Inches and Larger:

<u>MANUFACTURER</u>	<u>C500</u>	AWWA - MECH JT <u>C509</u>
American Darling	55	85
Clow Valve	F-5065	F-6100
Kennedy Valve	571X	1571X
Mueller-Hersey	A-2380-20	A-2370-20
Stockham Valve	G-743-O	G-701-O
U.S. Pipe	3460	5460
Waterous	300 Series	500 Series

- B. Rising Stem Gate Valves - 3 Inches and Larger:

<u>MANUFACTURER</u>	AWWA, FLANGED <u>C500</u>	<u>C509</u>
American Darling	52	82
Clow Valve	F-5072	F-6136
Kennedy Valve	566	1566
Mueller-Hersey	A-2483-6	A-2373-6
U.S. Pipe	3630	5120
Waterous	300 Series	500 Series

- C. Nonrising Stem Gate Valves - 2 Inches and Smaller:

<u>MANUFACTURER</u>	<u>MSS SP-80 THREADED</u>
Hammond Valve Corp.	IB645
Jenkins Bros.	370
Milwaukee Valve Co.	1105M
Nibco	T-113 w/iron HW
Stockham Valve	B-103

- D. Tapping Valves:

<u>MANUFACTURER</u>	
American Darling	565 or 865
Clow Valve	F-5093
Kennedy Valve	950X
Mueller-Hersey	H-667
U.S. Pipe	3860

E. Corporation Stops and Curb Stops:

<u>MANUFACTURER</u>	<u>CORP. STOPS</u>	<u>CURB STOPS</u>
Ford Meter Box	F Series	B Series
Hays	5000 Series	4000 Series
McDonald, A.Y.	3100, 4700 Series	6100 Series
Mueller-Hersey	H Series	H Series

F. Yard Hydrants, Post Type:

<u>MANUFACTURER</u>	
Ancon	HY-600-VB
Josam	71700 Series w/VB
Smith, Jay R.	5910 w/VB
Wade	W-8610 w/VB
Zurn	Z-1385-5
Woodford	W 34 w/VB

G. Yard Hydrants, Sanitary Type:

<u>MANUFACTURER</u>	
Murdock, Inc.	Expelo

3.12 WATER METER SCHEDULE

A. Disc-Type Water Meter:

<u>MANUFACTURER</u>	<u>AWWA C700</u>
Badger Meter	Recordall, bronze
Kent Meters	C-700 BP, C-700 TP
Mueller-Hersey	400, 500 Series
Rockwell Intl.	SR
Neptune	T-10

B. Compound-Type Water Meter:

<u>MANUFACTURER</u>	<u>AWWA C702</u>
Badger Meter	Compound Recordall
Kent Meters	C-3000 Combo
Mueller-Hersey	MCT II
Rockwell Intl.	SRH
Neptune	Tru/Flo

END OF SECTION 02668

SECTION 15010 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 15.
- B. This section applies to all Division 15 specification sections.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record documents.
 - 4. Rough-ins.
 - 5. Mechanical installations.
 - 6. Cutting and patching.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "BASIC MECHANICAL MATERIALS AND METHODS," for materials and methods common to the remainder of Division 15, plus general related specifications including:
 - a. Access to mechanical installations.
 - b. Excavation for mechanical installations within the building boundaries, and from building to utilities connections.

1.3 GOVERNING REGULATIONS AND AUTHORITIES

- A. Regulations include laws, ordinances, codes, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work, govern the execution of the work embodied in the contract documents, and the interpretation of the contract documents.
- B. Applicable codes and documents to this project are, but not limited to, the following:
 - 1. 2003 International Building Code - (with Utah amendments)
 - 2. 2003 International Mechanical Code - (with Utah amendments)
 - 3. 2003 International Plumbing Code - (with Utah amendments)
 - 4. 2003 International Energy Conservation Code.
 - 5. National Electrical Code - current edition

1.4 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS", and as outlined below.
1. By description, catalog number and manufacturer's name standards of quality have been established for certain manufactured equipment items and specialties which are to be furnished by this Division. Substitute products of equal or better quality may only be proposed for use if specifically named in the specifications or given written approval prior to bidding. Requests for substitution shall be made in accordance with the General Provisions.
 2. Within 45 days after the date of award of contract, and before commencement of work, a complete schedule of all equipment and materials proposed for installation shall be submitted.
 3. Submittal data for Division 15 shall be submitted arranged in a three-ring binder. Binder shall have a complete index with equipment listed in the same sequence as the sections in the specifications. Identify the equipment submitted with drawings, schedule number, and specification paragraph number.
 4. Submittals shall include, but not be limited to the following:
 - a. Scheduled Equipment Items
 - b. Vibration Elimination Devices
 - c. Seismic Restraint System
 - d. Valves
 - e. Insulation
 - f. Registers, Grilles, and Diffusers
 - g. Automatic Temperature Controls
 - h. Automation System
 - i. Plumbing Fixtures
 - j. Certificates of Guarantee
 5. Description of equipment shall include sizes, capacities, operating characteristics, brand names, motor horsepowers, accessories, materials gauges, manufacturer's maintenance instructions and other pertinent information required to establish quality of the products. List on the front of catalogs the page number referring to submitted items. Underline applicable data on the indicated pages. Where proposed equipment size varies from equipment first named, Contractor shall specifically call Architect's attention to that fact in writing at the time of submission of data.
 6. All submittal data shall be turned over to the Architect at one time. No consideration will be given to partial submittals.
 7. After engineering review, the Contractor may proceed to place an order for such item of equipment. However, actual fabrication by manufacturer may not commence until complete and accurate shop drawings have been submitted to Architect and have received his reviewed stamp and signature.
 8. A copy of the complete contract specification for the item, including motor requirements and any specific details of construction, shown on the drawings shall be sent to the factory furnishing such item, at the time the order is placed to avoid unnecessary errors.

9. The Contractor should protect himself with the supplier of alternate named equipment. Should Contractor submit on any item of equipment other than first named equipment in the specification and if alternate equipment is rejected or disapproved by the Architect for any of the reasons stated above, the Contractor shall be required to resubmit on first named equipment.
 10. All items other than first named specified equipment shall show and state all exceptions and deviations taken and shall include design calculations.
 11. The Contractor shall review the submittals prior to submission to make sure that submittals are complete in all details. Contractor shall verify equipment dimensions to fit the spaces provided with sufficient clearance for servicing the equipment. Submittals will not be reviewed which do not bear the Contractor's notation that such checking has been made.
 12. Equipment submittal shall show the proper arrangements to suit installation and maintenance such as motor location, access doors, filter removal, piping connections, etc.
 13. Equipment submittal sheets shall be clearly marked indicating equipment symbol and exact selection of proposed equipment.
 14. Review and acceptance of submittal does not relieve the Contractor of responsibility for fulfilling the contract requirements. Review of the submittal shall not change the contract requirements. Items not covered in the accepted submittal or items incorrectly covered but not recognized or identified shall not be used contrary to the contract documents.
 15. Verify electrical characteristics of all equipment with Division 16 before ordering any equipment.
- B. Increase, by the quantity listed below, the number of mechanical related shop drawings, product data, and samples submitted, to allow for required distribution plus one copy of each submittal required, which will be retained by the Mechanical Consulting Engineer.
1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
 2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
 3. Product Data: 1 additional copy of each item.
 4. Samples: 1 additional set.
- C. Additional copies may be required by individual sections of these Specifications.

1.5 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 Section "COORDINATION," to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Clearances for installing and maintaining insulation.

- b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - c. Equipment connections and support details.
 - d. Exterior wall and foundation penetrations.
 - e. Fire-rated wall and floor penetrations.
 - f. Sizes and location of required concrete pads and bases.
 - g. Valve stem movement.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "CONTRACT CLOSEOUT." In addition to the requirements specified in Division 1, indicate the following installed conditions:
 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 15 Section "Mechanical Identification." Indicate actual inverts and horizontal locations of underground piping.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
- B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in Division 1 Section "FIELD ENGINEERING" to record the locations and invert elevations of underground installations.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.8 WARRANTIES

- A. In addition to guarantee specified in General Conditions, guarantee heating and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

- B. That the circulation of water or glycol shall be complete and even.
- C. That all pipes, conduit, and connections shall be free from foreign matter and pockets and that all other obstructions to the free passage of water, liquid and vent shall be removed.
- D. That all devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system.
- E. All equipment and the complete system shall be guaranteed for a period of one year from the date of Substantial Completion. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period.
- F. Any failure that disables a heating or cooling system shall have repairs completed within 24 hours. If repair parts are not available in local stock, they shall be shipped via air freight at no charge to the owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Arrange equipment with factory panels, conduits, piping, etc. to allow proper access to equipment. Comply with clearances required by the National Electric Code.

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 16 for rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate mechanical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with manufacturers installation instructions and approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Not every offset, transition, or fitting is explicitly shown on the plans and these items shall be furnished by the contractor. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
9. Install new copper pipe as indicated on the drawings. If any pipe is found during construction that is galvanized and is not indicated to be replaced on the drawings, the contractor will immediately contact the owner before proceeding with any work on that portion of pipe.
10. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
11. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
12. Provide and install access panel or doors where mechanical devices such as valves, dampers, fire dampers, etc. are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "ACCESS DOORS AND FRAMES."
13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
14. Completely clean all mechanical equipment and systems of dirt, dust, debris and overspray at the time of substantial completion.
15. All factory-authorized equipment start-ups shall be witnessed by the Owner's representative, unless written exception is given. Any equipment start-ups completed without Owner's representative being present shall be repeated.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.
- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 1. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of "experienced Installer."
 - 2. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of "experienced Installer."

END OF SECTION 15010

SECTION 15052 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, **1/8-inch (3.2-mm)** maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping **NPS 1-1/2 (DN 40)** and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping **NPS 2 (DN 50)** and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for **250-psig (1725-kPa)** minimum working pressure at **180 deg F (82 deg C)**.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have **150- or 300-psig (1035- or 2070-kPa)** minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig (2070-kPa)** minimum working pressure at **225 deg F (107 deg C)**.
1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig (2070-kPa)** minimum working pressure at **225 deg F (107 deg C)**.
1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with copper material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece , cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.

- b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- L. Sleeves are not required for core-drilled holes.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

- 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
 - P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
 - S. Verify final equipment locations for roughing-in.
 - T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- ### 3.3 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 15052

SECTION 15053 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. HVAC demolition.
 - 2. Painting and finishing.
 - 3. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - EXECUTION

2.1 HVAC DEMOLITION

- A. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

2. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

- B. If pipe, insulation, duct, louver, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

2.2 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

2.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

2.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

2.5 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.

- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 15053

SECTION 15061 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe positioning systems.
 - 10. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 13 Section "Fire-Suppression Piping" for pipe hangers for fire-suppression piping.
 - 3. Division 15 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.

8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel .

1. Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Champion Fiberglass, Inc.
- c. Cope, T. J., Inc.; Tyco International, Ltd.
- d. Seasafe, Inc.
- e. Unistrut Corp.; Tyco International, Ltd.
- f. Wesanco, Inc.

- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

1. Manufacturers:

- a. Plasti-Fab, Inc. or approved equal.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Champion Fiberglass, Inc.
3. Cope, T. J., Inc.; Tyco International Ltd.
4. Seasafe, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

A. Description: **100-psig- (690-kPa-)** minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend **2 inches (50 mm)** beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.9 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Manufacturers:

- a. MIRO Industries or approved equal.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Manufacturers:
 - a. Portable Pipe Hangers or approved equal.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.11 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, **NPS 1/2 to NPS 8 (DN 15 to DN 200)**.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, **NPS 1/2 to NPS 2 (DN 15 to DN 50)**.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, **NPS 3/8 to NPS 8 (DN 10 to DN 200)**.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, **NPS 3/8 to NPS 3 (DN 10 to DN 80)**.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, **NPS 2-1/2 to NPS 36 (DN 65 to DN 900)**, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, **NPS 1 to NPS 30 (DN 25 to DN 750)**, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, **NPS 2-1/2 to NPS 20 (DN 65 to DN 500)**, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, **NPS 2 to NPS 42 (DN 50 to DN 1050)**, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, **NPS 2 to NPS 24 (DN 50 to DN 600)**, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, **NPS 2 to NPS 30 (DN 50 to DN 750)**, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, **NPS 3/4 to NPS 20 (DN 20 to DN 500)**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, **NPS 3/4 to NPS 20 (DN 20 to DN 500)**, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches (32 mm)**.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 15 Section "Plumbing Fixtures" for plumbing fixtures.

- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2 (DN 65)** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
 6. Insert Material: Length at least as long as protective shield.
 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to **1-1/2 inches (40 mm)**.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils (0.05 mm)**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15061

SECTION 15071 - MECHANICAL VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is part of each Division-15 section making reference to seismic and vibration control products specified herein.

1.2 SEISMIC AND VIBRATION CONTROL

- A. General: Division 15 shall be responsible for purchasing and installing vibration isolators, flexible connections, rigid steel frames, concrete inertia bases, anchors, inserts, hangers and attachments and seismic bracing and snubbers as required for seismic control and prevention of the transmission of vibration for both isolated and non-isolated systems.
- B. All mechanical equipment shall be designed for the site specific Seismic Zone as per the International Building Code.
- C. Reference Standards: The work shall comply to the following standards:
 - 1. International Building Code, current edition
 - 2. NFPA Bulletin 90A, current edition
 - 3. Bridge Bearing Specifications
- D. Design Parameters: Refer to Section 1621 of the 2003 International Building Code and ASCE 7-02.
- E. Approved Manufacturers:
 - 1. In order to insure that the requirements of the project are achieved, the Contractor must secure the services of a manufacturer or supplier who has proven capabilities of dealing effectively with vibration characteristics, effects and criteria and can provide facilities and capabilities for measuring, evaluating and designing for seismic disturbances.
 - 2. Manufacturers approved for use are:
 - a. Mason Industries, Inc.
 - b. Amber/Booth Company.
 - c. Vibration Eliminator Co.
 - d. Kinetics Noise Control.
 - 3. The Manufacturer's responsibilities shall include designing and providing all vibration isolators and seismic restraints. He shall also be responsible for the proper installation of these components. Periodic inspections to the job site will be made as required. He shall make a final inspection and submit a report to the Architect certifying compliance to these

- specifications, drawings and related standards. Provide submittals as specified.
4. The Manufacturer's responsibilities shall include designing and providing all vibration isolators and seismic restraints. He shall also be responsible for the proper installation of these components. Periodic inspections to the job site will be made as required. The professional engineer who performs the calculations shall make a final inspection and submit a report to the Architect certifying compliance to these specifications, drawings and related standards. The Owner shall be notified in advance when the seismic engineer will be performing final certification inspection. The Owner may wish to be present for this inspection. Provide submittals as specified.
- F. Submittals: Submittal data prior to fabrication, shall include but not be limited to the following:
1. Complete engineering calculations and shop drawings for all vibration and seismic requirements for all equipment, piping and ductwork.
 2. The Utah State professional stamp of the Engineer who is responsible for the design and operation of the Vibration and Seismic System.
 3. The type, size, and deflection of each isolator proposed for items in this specification and on the drawings.
 4. Details for all the isolators and seismic bracing with snubbers proposed for items in this specification and on the drawings.
 5. Details for steel frames and concrete inertia bases to be used in conjunction with the isolation and seismic restraint of the items in this specification and drawings.
 6. Clearly outlined procedures for installing and adjusting the isolators, seismic bracing and snubber.
 7. The size, loading and location of pipe and duct supports with an as-built plan or complete description of the system.
- G. Vibration Isolation:
1. All mechanical equipment 1 HP, and over unless otherwise noted, shall be isolated from the structure by means of resilient vibration and noise isolators designed and supplied by the Seismic and Vibration Control Manufacturer. Piping and ductwork connected to vibrating equipment shall be isolated from the structure as required to prevent vibration transmission. Isolation equipment, hangers, connections, and other isolating devices shall be designed and installed to prevent transmission of vibration to the structure from the mechanical equipment or any of the associated piping and ductwork.
 2. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases unless the equipment manufacturer certified direct attachment capability. The steel frames and bases on isolated equipment shall be provided by the Seismic and Vibration Control Manufacturer.
- H. Vibration isolators shall be provided as follows and as otherwise indicated:
1. The Automatic Temperature Control air compressors shall be mounted on Type P neoprene pads.
 2. Floor mounted pumps shall be mounted on Type P neoprene pads.

3. Suspended exhaust fans and air handling units shall be suspended on Type D spring hangers with neoprene element.
 4. Floor mounted air handlers without internal vibration isolation shall be mounted on type B springs with type H base or housed type spring isolator with integral seismic restraint.
 5. Centrifugal supply fans shall be mounted on Type G structural steel base with Type B springs.
 6. Centrifugal relief/exhaust fans shall be mounted on Type J concrete inertia base with Type B springs.
 7. Boilers on grade support in Type P Neoprene Isolators. Boilers on suspended slabs support from Type C spring mounting.
 8. Vertical pipe risers shall be supported with Type E precompressed spring hangers with neoprene element to allow for thermal expansion.
 9. Roof mounted and floor mounted utility exhaust fans shall be mounted on housed type spring isolators with integral seismic restraint.
 10. Isolate all water, steam and refrigerant piping 1-1/2" and larger within each mechanical equipment room which contains vibration isolated equipment. Isolators shall be Type D spring hangers with neoprene elements.
 11. Isolate all water, steam and refrigerant piping that is connected to vibration isolated equipment, for a distance of at least 50 feet from the equipment. Isolators shall be Type D spring hangers.
 12. Isolate all ductwork within the mechanical equipment rooms which contain vibration isolated equipment. Isolators shall be Type D spring isolators with neoprene elements.
 13. Isolate all ductwork that is connected to vibration isolated equipment, for a distance of at least 50 feet from the equipment. Isolators shall be Type D spring hangers with neoprene elements.
 14. Isolate all piping in chiller room. Isolators shall be Type D spring hangers.
- I. Vibration isolators shall be as follows:
1. Type B Spring Mounting: Spring type isolators shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc. or equal by Amber-Booth.
 2. Type C Spring Mounting: Equipment with operating weight different from the installed weight, such as chillers, boilers, etc. and equipment exposed to the wind, such as cooling towers, shall be mounted on spring mountings Type B, but a housing shall be used that includes vertical limit stops to prevent spring extension when weight is removed. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical and horizontal directions. The housing shall serve as blocking during erection and cooling tower mounts shall be located between the supporting steel and roof or the grillage and dunnage as shown on the drawings. The installed and operating heights shall be the same. A

minimum clearance of 3/8" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operations. Mounting used out of doors shall be hot dipped galvanized. Mountings shall be SLR as manufactured by Mason Industries, Inc. or equal by Amber-Booth.

3. Type D Spring Hangers: Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be type 30N as manufactured by Mason Industries, Inc. or equal by Amber-Booth.
4. Type E Spring Hangers: Vibration hangers shall be Type D, but they shall be precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to it's full load. Deflection shall be clearly indicated by means of a scale. Hangers shall be type PC30N as manufactured by Mason Industries, Inc. or equal by Amber-Booth.
5. Type F Spring Hangers: Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be type W30 as manufactured by Mason Industries, Inc. or equal by Amber-Booth.
6. Type G Steel Bases: vibration isolator manufacturer shall furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be 'T' or 'L' shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch. Bases shall be type WF as manufactured by Mason Industries, Inc. Mount on Mason SSFLH spring isolators with integral seismic restraints.
7. Type H Steel Bases: Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a compete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment.

Inverted saddles shall be Type ICS as manufactured by Mason Industries, Inc., or equal by Amber-Booth.

8. Type J Concrete Inertia Bases: Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of half-inch bars or angles welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Bases shall be Type K as manufactured by Mason Industries, Inc.
9. Type P Neoprene Pad: A pad type mounting consisting of two layers of 3/8" thick ribbed or waffled bridge bearing neoprene pads bonded to a 16 gage galvanized steel separator plate. Anchor bolt with neoprene washer and sleeve.

J. Seismic Restraints:

1. General: The intent of the seismic restraints is to restrain the mechanical equipment, pipes and ducts during an earthquake for life safety purposes; to prevent equipment from overturning; to prevent suspended equipment, pipes and ducts from swaying or falling and creating a potential life safety hazard. For "Essential" and "Hazardous" facilities (as defined in the International Building Code), the intent of the seismic restraint system also includes keeping the mechanical systems operational during and following an earthquake. See Section 05500 "Metal Fabrication" for standards for miscellaneous metal fabrication.
2. The following mechanical items shall be seismically braced as specified, detailed on the drawings, or as recommended by the Seismic and Vibration Control manufacturer:
 - a. Paint Booth - anchor bolts
 - b. Foundry Hood - anchor bolts
 - c. Heat Transfer Package - anchor bolts
 - d. Roof Hoods - anchor bolts
 - e. Packaged Rooftop Air Handlers - anchor bolts
 - f. Hot Water Unit Heaters - cables
 - g. Evaporative Cooler - anchor bolts
 - h. Water Storage Tanks - anchor bolts and cables
 - i. Cooling Tower - anchor bolts
 - j. Vaneaxial Supply Fans - seismic snubbers or restrained isolators
 - k. Chillers - anchor bolts
 - l. ATC Air Compressor - anchor bolts (seismic snubbers or restrained isolators)
 - m. Heat Exchangers - anchor bolts and cables
 - n. Air Handler - anchor bolts
 - o. Base Mounted Pumps - anchor bolts

- p. Water Softeners and Brine Tanks - anchor bolts or cables
 - q. Expansion Tanks - cables or anchor bolts
 - r. Relief Fans - angle iron or cables
 - s. Boiler - anchor bolts
 - t. Water Heater - anchor bolts
 - u. Inline Exhaust Fans - cables
 - v. Suspended Air Handlers - cables
 - w. Roof Exhaust Fans - anchor bolts
 - x. Water Treatment Station - anchor bolts
 - y. All duct work and piping shall be provided with seismic restraints in accordance with the current edition of the International Building Code. Insulated piping longitudinal restraints shall be attached directly to piping.
- 3. Connections of the seismic bracing to the structure shall be coordinated with the General Contractor and acceptable to the Structural Engineers. In general, connect to beams, concrete slabs, or to the top member of the joists at the panel points. Division 15 shall provide spanner beams where required for seismic bracing. Seismic anchorage shall extend through concrete house keeping pads and anchor to the building floor slabs.
 - 4. The Seismic and Vibration Control manufacturer shall determine the number, size, and type of anchor bolts, cable restraints, seismic snubbers, etc., for each piece of equipment and groups of pipes and ducts. Individual pipes and ducts shall be braced as per the SMACNA details and approved and verified by the Seismic and Vibration Control manufacturer.
- K. Seismic Snubbers:
- 1. All vibration isolated equipment shall be mounted on rigid steel frames or concrete bases as described in the vibration control specifications unless the equipment manufacturer certifies direct attachment capability. Each spring mounted base shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment both to the base and the structure. The snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of 3/4" thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more than 1/4". Snubbers shall be installed with factory set clearances.
 - 2. The capacity of the seismic snubber at 3/8" deflection shall be 3 to 4 times the load assigned to the mount grouping in its immediate area. Submittals shall include load deflection curves up to 1/2" deflection in the y and z planes. Test shall be conducted in an independent laboratory or under the signed supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the neoprene elements nor the snubber body sustained any obvious deformation after release of load. Snubbers shall be series Z-1011 as manufactured by Mason Industries, Inc. or equal by Amber-Booth.

END OF SECTION 15071

SECTION 15076 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) Stainless steel, 0.025-inch (0.64-mm) Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black .
3. Background Color: White .
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/8 inch (3.2 mm)** thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black .
- C. Background Color: White .
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F (71 deg C)**.
- E. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch (64 by 19 mm)**.
- F. Minimum Letter Size: **1/4 inch (6.4 mm)** for name of units if viewing distance is less than **24 inches (600 mm)**, **1/2 inch (13 mm)** for viewing distances up to **72 inches (1830 mm)**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least **1-1/2 inches (38 mm)** high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of **3/4 inch (19 mm)** for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 1. Tag Material: Brass, 0.032-inch (0.8-mm) Stainless steel, 0.025-inch (0.64-mm) Aluminum, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Fasteners: Brass wire-link or beaded chain; or S-hook .
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7 inches (100 by 178 mm).
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of **50 feet (15 m)** along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: White .
 - b. Letter Color: Black .

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches (50 mm), square.
 - b. Hot Water: 2 inches (50 mm), square.
2. Valve-Tag Color:
 - a. Cold Water: Green.
 - b. Hot Water: Green.
3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15076

SECTION 15080 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe, duct, and equipment insulation.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

1.3 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/sq.ft.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.
- C. Material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.
 - 1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
 - 2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.
- B. Field-Constructed Mock-Up: Before installation, erect mock-up of size and at locations indicated to demonstrate workmanship quality. Include method of attachment and finishing for each.
 - 1. Interior and exterior equipment.
 - 2. Interior and exterior duct systems.
 - 3. Interior and exterior piping systems.
 - 4. Retain and protect mock-ups during construction as a standard for judging completed unit of Work.
 - 5. Remove mock-ups from Project site when directed.
 - 6. Accepted mock-ups may become part of completed unit of Work.

1.6 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping and duct systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glass Fiber:
 - a. CertainTeed Corporation.
 - b. Knauf Fiberglass GmbH.
 - c. Manson.
 - d. Owens-Corning Fiberglas Corporation.
 - e. John Manville.
 - f. USG Interiors, Inc. - Thermafiber Division.
 - 2. Flexible Elastomeric Cellular:
 - a. Armstrong World Industries, Inc.
 - b. Halstead Industrial Products.
 - c. IMCOA.
 - d. Rubatex Corporation.
 - 3. Calcium Silicate:
 - a. Owens-Corning Corporation.

b. John Manville.

4. Fire Rated Insulation Wrap for Grease Ducts:
- a. Thermal Ceramics.
 - b. Pyroscat by Premier.
 - c. Fire Master Duct Wrap by 3M Fire Protection Products.
 - d. Certainteed "Flame Chek".

2.2 GLASS FIBER

- A. Material: Inorganic glass fibers, bonded with a thermosetting resin.
- B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.
- C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.
1. Thermal Conductivity: 0.26 average maximum, at 75 deg F mean temperature.
 2. Density: 6 pcf average maximum.
- D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.
1. Thermal Conductivity: 0.32 average maximum, at 75 deg F mean temperature.
- E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.
1. Thermal Conductivity: 0.25 average maximum at 75 deg F mean temperature.
 2. Density: 10 pcf average maximum.
- F. Adhesive: Produced under the UL Classification and Follow-up service.
1. Type: Non-flammable, solvent-based.
 2. Service Temperature Range: Minus 20 to 180 deg F.
- G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

- A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
1. Tubular Materials: ASTM C 534, Type I.
 2. Sheet Materials: ASTM C 534, Type II.
- B. Thermal Conductivity: 0.30 average maximum at 75 deg F.
- C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 CALCIUM SILICATE

- A. Material: ASTM C 533, Type I; inorganic, hydrous calcium silicate, non-asbestos fibrous reinforcement; incombustible.

- B. Form: Molded flat block, curved block, grooved block, and preformed pipe sections as appropriate for surface.
- C. Thermal Conductivity: 0.60 at 500 deg F.
- D. Dry Density: 15.0 pcf maximum.
- E. Compressive Strength: 60 psi minimum at 5 percent deformation.
- F. Fire Performance Characteristics: Provide materials identical to those whose fire performance characteristics have been determined, per test method indicated below, by UL or other testing and inspecting organization acceptable to authorities having jurisdiction.
 - 1. Test Method: ASTM E 84.
 - 2. Flame Spread: 0.
 - 3. Smoke Developed: 0.

2.5 INSULATING CEMENTS

- A. Mineral Fiber: ASTM C 195.
 - 1. Thermal Conductivity: 1.0 average maximum at 500 deg F mean temperature.
 - 2. Compressive Strength: 10 psi at 5 percent deformation.
- B. Expanded or Exfoliated Vermiculite: ASTM C 196.
 - 1. Thermal Conductivity: 1.10 average maximum at 500 deg F mean temperature.
 - 2. Compressive Strength: 5 psi at 5 percent deformation.
- C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
 - 1. Thermal Conductivity: 1.2 average maximum at 400 deg F mean temperature.
 - 2. Compressive Strength: 100 psi at 5 percent deformation.

2.6 ADHESIVES

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
 - 1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
 - 2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.7 JACKETS

- A. General: ASTM C 921, Type 1, except as otherwise indicated.

- B. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, roll stock ready for shop or field cutting and forming to indicated sizes or factory cut and rolled to indicated sizes.
 - 1. Moisture Barrier: 1-mil, heat-bonded polyethylene and kraft paper.
 - 2. Moisture Barrier: 3-mil Dupont Surlyn.
 - 3. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

2.8 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
 - 1. Tape Width: 4 inches.
 - 2. Cloth Standard: MIL-C-20079H, Type I.
 - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:
 - 1. Stainless Steel: Type 304, 0.020 inch thick.
 - 2. Galvanized Steel: 0.005 inch thick.
 - 3. Aluminum: 0.007 inch thick.
 - 4. Brass: 0.01 inch thick.
 - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.
- D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.9 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
 - 1. Water Vapor Permeance: 0.08 perm maximum.
 - 2. Temperature Range: Minus 20 to 180 deg F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
 - 1. Water Vapor Permeance: 0.02 perm maximum.
 - 2. Temperature Range: Minus 50 to 250 deg F.
 - 3. Color: Aluminum.

2.10 FIRE RATED INSULATION WRAP

- A. Flammability: ASTM E84/UL 723.
 - 1. Flame Spread: 5.
 - 2. Smoke Developed: 5.

- B. Thermal Resistance:
 - 1. R Value per ASTM C 518: 4.5 per inch at 70°F.
 - 2. R Value per ASTM C 177: 9.9 per inch at -283°F (4 pcf).
- C. Physical Properties:
 - 1. Service Range: To 2300°F.
 - 2. Melting Point: 3200°F.
 - 3. Color: White.
- D. Maximum Quantities of Water Leachable Elements (PPM) on Fiber Surface:
 - 1. Boron 100; Chlorine 5; Fluorine 50; Sulphur 10.
- E. Chemical Analysis (% Weight Basis After Firing):
 - 1. Alumina (Al_2O_3), 45; Silica (SiO_2), 53; other 1-2.
- F. Chemical Properties: Duct Wrap Blanket possesses excellent resistance to chemical attack. Exceptions include hydrofluoric acid, phosphoric acid, and strong alkalis. Unaffected by oil or water, thermal and physical properties are restored after drying.
- G. Foil Physical Properties:
 - 1. Puncture Resistance - Beach (ASTM D-781):
 - a. 100 units minimum.
 - 2. Tensile Strength (ASTM D-828):
 - a. M.D. 40 lbs/in. width average.
 - b. C.D. 40 lbs/in. width average.
 - 3. Bond:
 - a. Unable to delaminate without destroying the facing.
 - 4. Light Reflectance (ASTM C-523 [500nm]):
 - a. 90.5%.
- H. Environmental Testing:
 - 1. Weather Resistance:
 - a. No corrosion or delamination at 120°F, 95% relative humidity for 30 days.
 - 2. Temperature Resistance:
 - a. The laminate withstands 4 hours at 150°F without delamination.
 - 3. Water Resistance:
 - a. Withstands 24 hour H₂O immersion at 70°F without delamination.
 - 4. Cold Weather Flexibility, Masland Cold Crack (ASTM D-1790):
 - a. At -40°F passes with no cracking of polypropylene surface.
 - 5. Dimensional Stability (ASTM D-1204):
 - a. C.D. $\pm 0.125\%$.
 - b. M.D. $\pm 0.125\%$.

2.11 MATERIALS AND EQUIPMENT FOR FIRE RATED INSULATION WRAP

- A. High performance filament tape, 1" wide, manufactured by 3M Company, St. Paul, Minnesota, tape number 898 or its equivalent.

- B. Banding material, 3/4" wide, minimum 0.015" thick, carbon steel for construction requirements of zero clearance to combustibles or 1 hour ratings. Stainless steel banding is used for 2 hour requirements (SS wire ties or 1/2" SS hose clamps may be substituted for hanger insulation only).
- C. Hand bander tensioning tool; seals and crimping tool.
- D. 10 gage, 4" to 5" long, copper coated steel pins; 1-1/2" X 1-1/2" galvanized steel speed clips; capacitor discharge stud gun (110/115) such as that manufactured by AGM.
- E. Grease Duct Access Door Hardware: 4-1/2" to 5" long, 1/4" diameter galvanized steel threaded rods with 1/4" wing nuts and 1/4" metal washers; 4" long steel hollow tubing to fit threaded rods.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.
- B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.
 - 1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

- A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.
- B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.
- C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60 deg F.
- D. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.
- E. Install insulation with smooth, straight, and even surfaces.
- F. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.
- G. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

- H. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.
- I. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.
- J. Keep insulation materials dry during application and finishing.
- K. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:
 - 1. Fibrous glass ducts.
 - 2. Metal ducts with duct liner located inside building insulation envelope.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
 - 5. Flexible connectors for ducts and pipes.
 - 6. Vibration control devices.
 - 7. Testing laboratory labels and stamps.
 - 8. Nameplates and data plates.
 - 9. Access panels and doors in air distribution systems.
 - 10. Fire protection piping systems.
 - 11. Sanitary drainage and vent piping, unless indicated otherwise.
 - 12. Drainage piping located in crawl spaces, unless indicated otherwise.
 - 13. Below grade buried piping.
 - 14. Chrome-plated pipes and fittings, except for plumbing fixtures for the disabled.
 - 15. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.
 - 16. Factory insulated equipment.

3.3 PIPE INSULATION INSTALLATION, GENERAL

- A. Tightly butt longitudinal seams and end joints. Bond with adhesive.
- B. Stagger joints on double layers of insulation.
- C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.
- D. Apply insulation with a minimum number of joints.
- E. Apply insulation with integral jackets as follows:
 - 1. Pull jacket tight and smooth.
 - 2. Cover circumferential joints with butt strips, at least 3-inches wide, and of same material as insulation jacket. Secure with adhesive and outward clinching staples along both edges of butt strip and space 4 inches on center.
 - 3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry

- surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches on center.
- a. Exception: Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 deg F.
4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.
6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere, staple, and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.
- F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.
- G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.
- H. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.
- I. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer. Refer to Division 7 Section "Joint Sealants."
- J. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer. Refer to Division 7 for firestopping and fire-resistant joint sealers.
- K. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.
- L. Flanges, Fittings, Valves, and Roof Drain Bowls - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges,

unions, valves, fittings, and roof drain bowls. Make joints tight. Bond with adhesive.

1. Use same material and thickness as adjacent pipe insulation.
2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.
3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.
4. Insulate elbows and tees smaller than 3-inches pipe size with premolded insulation.
5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.
6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.

M. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. Install saddles, shields, and inserts as specified in Division 15 Section "Hangers and Supports." For cold surface piping, extend insulation on anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

3.4 GLASS FIBER PIPE INSULATION INSTALLATION

- A. Bond insulation to pipe with lagging adhesive.
- B. Seal exposed ends with lagging adhesive.
- C. Seal seams and joints with vapor barrier compound.

3.5 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

- A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.
- B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.
 1. Miter cut materials to cover soldered elbows and tees.
 2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.6 CALCIUM SILICATE PIPE INSULATION INSTALLATION

- A. Secure insulation with stainless-steel bands spaced at 12-inch intervals.
- B. Apply 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 16-gage soft-annealed stainless-steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

- C. Finishing: Apply a skim coat of mineral fiber, hydraulic-setting cement to surface of installed insulation. When dry, apply flood coat of lagging adhesive and press on 1 layer of glass cloth or glass tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth finish.
- D. Metal Jacket: Where indicated, apply metal jacket over finished insulation as specified in this Section for installation of metal jackets.

3.7 EQUIPMENT INSULATION INSTALLATION, GENERAL

- A. Install board and block materials with a minimum dimension of 12 inches and a maximum dimension of 48 inches.
- B. Groove and score insulation materials as required to fit as closely as possible to the equipment and to fit contours of equipment. Stagger end joints.
- C. Insulation Thicknesses Greater than 2 Inches: Install insulation in multiple layers with staggered joints.
- D. Bevel insulation edges for cylindrical surfaces for tight joint.
- E. Secure sections of insulation in place with wire or bands spaced at 9-inch centers, except for flexible elastomeric cellular insulation.
- F. Protect exposed corners with corner angles under wires and bands.
- G. Manholes, Handholes, and Information Plates: Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
- H. Removable Insulation: Install insulation on components that require periodic inspecting, cleaning, and repairing for easy removal and replacement without damage to adjacent insulation.
- I. Pumps: Where insulation is indicated, fabricate galvanized steel boxes lined with insulation. Fit boxes around pumps and coincide joints in box with the splits in the pump casings. Fabricate joints with outward bolted flanges.
- J. Finishing: Except for flexible elastomeric cellular insulation, apply 2 coats of vapor barrier compound to a minimum thickness of 1/16 inch. Install a layer of glass cloth embedded between layers.

3.8 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

- A. Secure insulation with anchor pins and speed washers.
- B. Space anchors at maximum intervals of 18 inches in both directions and not more than 3 inches from edges and joints.
- C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.9 FLEXIBLE ELASTOMERIC CELLULAR EQUIPMENT INSULATION INSTALLATION

- A. Install sheets of the largest manageable size.
- B. Apply full coverage of adhesive to the surfaces of the equipment and to the insulation.
- C. Butt insulation joints firmly together and apply adhesive to insulation edges at joints.

3.10 DUCT INSULATION

- A. Install block and board insulation as follows:
 - 1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.
 - 2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.
- B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:
 - 1. Smaller Than 24 Inches: Bonding adhesive applied in 6-inch-wide transverse strips on 12-inch centers.
 - 2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.
 - 3. Overlap joints 3 inches.
 - 4. Seal joints, breaks, and punctures with vapor barrier compound.
- C. Fire rated insulation wrap for grease ducts to be installed as per manufacturer's instructions.

3.11 JACKETS

- A. Interior Exposed Insulation: Install continuous aluminum jackets.
- B. Exterior Exposed Insulation: Install continuous aluminum jackets and seal all joints and seams with waterproof sealant.

3.12 FINISHES

- A. Paint finished insulation (except colored PVC jacket) as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.13 APPLICATIONS

- A. General: Materials and thicknesses are specified in schedules at the end of this Section.
- B. Interior Piping Systems: Unless otherwise indicated, insulate the following piping systems:
 - 1. Domestic cold water.
 - 2. Domestic hot water.
 - 3. Recirculated hot water.
- C. Equipment: Unless otherwise indicated, insulate the following indoor equipment:
 - 1. Domestic hot water equipment, tanks, and water heaters.
- D. Duct Systems: Unless otherwise indicated, insulate the following unlined duct systems:
 - 1. Interior concealed unlined supply, combustion, and outside air ductwork.
 - 2. Interior exposed unlined supply, combustion, and outside air ductwork.
 - 3. Exterior exposed supply and return air ductwork.
 - 4. Interior exposed and concealed supply fans, air handling unit casings and outside air plenums.
 - 5. Interior exposed grease exhaust ductwork.
 - 6. Interior concealed grease exhaust ductwork.
 - 7. Interior exposed non-grease and dishwasher exhaust ductwork.
 - 8. Interior concealed non-grease and dishwasher exhaust ductwork.

3.14 PIPE INSULATION SCHEDULES

- A. General: Abbreviations used in the following schedules include:
 - 1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel, C - Glass Cloth.
 - 2. Pipe Sizes: NPS - Nominal Pipe Size.
 - 3. All system piping shall be thermally insulated in accordance with ASHRAE 90.1-99, table 6.2.4.5.

INTERIOR DOMESTIC COLD WATER, STORM WATER, PLUMBING
VENTS WITHIN 6 LINEAL FEET OF ROOF
OUTLET, (40 TO 60 DEG. F)
(≤ Less than or Equal to) (>Greater than)

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
≤1-1/2	GLASS FIBER	1	YES	CONCEALED (NONE) EXPOSED (A)(P)(C)
>1-1/2	GLASS FIBER	1	YES	CONCEALED (NONE) EXPOSED (A)(P)(C)

INTERIOR DOMESTIC HOT WATER AND RECIRCULATED HOT WATER
(105 TO 180 DEG. F)

PIPE SIZES (NPS)	MATERIALS	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
≤1-1/2	GLASS FIBER	1	NO	CONCEALED (NONE) EXPOSED (A)(P)(C)
>1-1/2	GLASS FIBER	1	NO	CONCEALED (NONE) EXPOSED (A)(P)(C)

3.15 EQUIPMENT INSULATION SCHEDULES

INTERIOR EXPOSED DOMESTIC HOT WATER EQUIPMENT,
TANKS, AND PUMPS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BLOCK	2	NO	(A)(C)
CALCIUM SILICATE	BLOCK	2	NO	(A)(C)

3.16 DUCT SYSTEMS INSULATION SCHEDULE

INTERIOR CONCEALED UNLINED HVAC SUPPLY, COMBUSTION, AND OUTSIDE AIR DUCTS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BLANKET	1-1/2	YES	NONE

INTERIOR EXPOSED UNLINED HVAC SUPPLY, COMBUSTION, AND OUTSIDE AIR DUCTS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	1-1/2	YES	NONE
GLASS FIBER	PIPE - ROUND	1-1/2	YES	NONE

EXTERIOR CONCEALED HVAC SUPPLY AND RETURN AIR DUCTS

MATERIAL	FORM	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD- APPLIED JACKET
GLASS FIBER	BOARD - RECT.	2	YES	NONE
GLASS FIBER	PIPE - ROUND	2	YES	NONE

END OF SECTION 15080

SECTION 15110 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Special purpose valves are specified in Division 15 piping system Sections.
 - 2. Valve tags and charts are specified in Division 15 Section "Mechanical Identification."

1.3 SUBMITTALS

- A. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- B. Maintenance data for valves to include in the operation and maintenance manual. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set globe and gate valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.

5. Set butterfly valves closed or slightly open.
 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ball Valves:
 - a. Conbraco Industries, Inc.; Apollo Division.
 - b. Crane Company; Valves and Fitting Division.
 - c. Hammond Valve Corporation.
 - d. Jamesbury.
 - e. Jenkins Valve.
 - f. Lunkenheimer/Cincinnati Valve Co.
 - g. Milwaukee Valve Company, Inc.
 - h. NIBCO Inc.
 - i. Powell: Wm. Powell Company (The).
 - j. Stockham Valves & Fittings, Inc.
 - k. Tyco, Keystone.
 - l. Tyler Pipe.
 - m. Victaulic Company of America.
 - n. Watts Industries, Inc.
 2. Butterfly Valves:
 - a. Bray Valve and Controls.
 - b. Center Line, Mark Controls Corporation.
 - c. Crane Company; Valves and Fitting Division.
 - d. General Signal; DeZurik Unit.
 - e. Grinnell Corp.
 - f. Hammond Valve Corporation.
 - g. Milwaukee Valve Company, Inc.
 - h. NIBCO Inc.
 - i. Powell: Wm. Powell Company (The).
 - j. Red-White Valve Corp.
 - k. Stockham Valves & Fittings, Inc.
 - l. Tyco, Keystone.
 - m. Tyler Pipe.
 - n. Ultraflo Corporation.

- o. Victaulic Company of America.
 - p. Watts Industries, Inc.
- 3. Swing Check Valves:
 - a. Cla-Val Co.
 - b. Crane Company; Valves and Fitting Division.
 - c. Hammond Valve Corporation.
 - d. Jenkins Valve.
 - e. Kitz Corp. of America.
 - f. Lunkenheimer/Cincinnati Valve Co.
 - g. Milwaukee Valve Company, Inc.
 - h. NIBCO Inc.
 - i. Powell: Wm. Powell Company (The).
 - j. Red-White Valve Corp.
 - k. Stockham Valves & Fittings, Inc.
 - l. Tyco, Prince.
 - m. Victaulic Company of America.
 - n. Watts Industries, Inc.
- 4. Wafer Check Valves:
 - a. Cla-Val Co.
 - b. Center Line, Mark Controls Corp.
 - c. Conbraco Industries, Inc.; Apollo Division.
 - d. Hammond Valve Corporation.
 - e. Kitz Corp. of America.
 - f. Metraflex Company.
 - g. Milwaukee Valve Company, Inc.
 - h. NIBCO Inc.
 - i. Red-White Valve Corp.
 - j. Stockham Valves & Fittings, Inc.
 - k. Tyco, Prince.
 - l. Tyler Pipe.
 - m. Val-Matic Valve & Mfg. Corp.
 - n. Victaulic Company of America.
 - o. Watts Industries, Inc.
- 5. Lift Check Valves:
 - a. Crane Company; Valves and Fitting Division.
 - b. Hammond Valve Corporation.
 - c. Jenkins Valve.
 - d. Kitz Corp. of America.
 - e. Lunkenheimer/Cincinnati Valve Co.
 - f. Milwaukee Valve Company, Inc.
 - g. NIBCO Inc.
 - h. Powell: Wm. Powell Company (The).
 - i. Red-White Valve Corp.
 - j. Stockham Valves & Fittings, Inc.
 - k. Watts Industries, Inc.

2.2 BASIC, COMMON FEATURES

- A. Design: Rising stem or rising outside screw and yoke stems, except as specified below.
 - 1. Nonrising stem valves may be used only where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Use specified operators and handwheels, except provide the following special operator features:
 - 1. Handwheels: For valves other than quarter turn.
 - 2. Lever Handles: For quarter-turn valves **6 inches (DN150)** and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
 - 3. Chain-Wheel Operators: For valves **4 inches (DN100)** and larger, installed **72 inches (2400 mm)** or higher above finished floor elevation.
 - 4. Gear-Drive Operators: For quarter-turn valves **8 inches (DN200)** and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- G. Threads: ASME B1.20.1.
- H. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- I. Solder Joint: ASME B16.18.
 - 1. Caution: Where soldered end connections are used, use solder having a melting point below **840 deg F (450 deg C)** for gate, globe, and check valves; below **421 deg F (216 deg C)** for ball valves.

2.3 BALL VALVES

- A. Ball Valves, **4 Inches (DN100)** and Smaller: MSS SP-110, Class 150, **600-psi (4140-kPa)** CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for **1/2-inch (DN15)** valves and smaller and conventional port for **3/4-inch (DN20)** valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
 - 1. Operator: Vinyl-covered steel lever handle.
 - 2. Operator: Lever operators with lock where used for throttling duty.
 - 3. Stem Extension: For valves installed in insulated piping.

4. Memory Stop: For operator handles where used for throttling duty.

2.4 BUTTERFLY VALVES

- A. Butterfly Valves: MSS SP-67, **200-psi (1380-kPa)** CWP, **150-psi (1035- kPa)** maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, wafer, lug, or grooved style:
 1. Disc type as indicated in application schedule:
 - a. Nickel-plated ductile iron.
 - b. Aluminum bronze.
 - c. Elastomer-coated ductile iron.
 - d. Epoxy-coated ductile iron.
 2. Operator for Sizes **2 Inches (DN50)** to **6 Inches (DN150)**: Standard lever handle with memory stop.
 3. Operator for Sizes **8 Inches (DN200)** to **24 Inches (DN600)**: Gear operator with position indicator.
 4. Operator for Sizes **8 Inches (DN200)** and Larger, **96 Inches (2400 mm)** or Higher above Floor: Chain-wheel operator.

2.5 CHECK VALVES

- A. Swing Check Valves, **2-1/2 Inches (DN65)** and Smaller: MSS SP-80; Class 125, **200-psi (1380-kPa)** CWP, or Class 150, **300-psi (2070-kPa)** CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections.
- B. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 300; cast bronze body and cap conforming to ASTM B 61; with threaded ends, horizontal swing, Y-pattern, and bronze disc, and regrinding seat.
- C. Swing Check Valves, **3 Inches (DN80)** and Larger: MSS SP-71, Class 125, **200-psi (1380-kPa)** CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.
- D. Swing Check Valves, 2-1/2-Inch and Larger: Class 300; steel body and cap conforming to ASTM A 216 Grade WCB; with flanged ends, horizontal swing, and 11-1/2 - 13 chromium stainless with "Stellite" trim.
- E. Wafer Check Valves: Class 125, **200-psi (1380-kPa)** CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.
- F. Lift Check Valves: Class 125, ASTM B 62 bronze body and cap (main components), horizontal or vertical pattern, lift-type, bronze disc or Buna N rubber disc with stainless-steel holder threaded or soldered end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Install new valves to replace existing ones found in all galvanized pipe. Valves are not indicated on drawings.
- C. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- D. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- E. Locate valves for easy access and provide separate support where necessary.
- F. Install valves in horizontal piping with stem at or above the center of the pipe.
- G. Install valves in a position to allow full stem movement.
- H. For chain-wheel operators, extend chains to **60 inches (1500 mm)** above finished floor elevation.
- I. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Lift Check Valve: With stem upright and plumb.

3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Protect valves from damage while soldering.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.6 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, **2-1/2 Inches (DN65)** and Smaller: Solder ends, except provide threaded ends for heating hot water, chilled water, condenser water, low-pressure steam, and high-pressure steam service.
2. Steel Pipe Sizes, **2-1/2 Inches (DN65)** and Smaller: Threaded or grooved end.
3. Steel Pipe Sizes, **3 Inches (DN80)** and Larger: Grooved end or flanged.

3.7 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 1. Ball Valves: Class 150, **600-psi (4140-kPa)** CWP, with stem extension.
 2. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
 3. Bronze Swing Check: Class 125, with rubber seat.
 4. Check Valves: Class 125, swing or wafer type as indicated.

3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 15110

SECTION 15123 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal-bellows expansion joints.
 - 2. Rubber expansion joints.
 - 3. Flexible-hose expansion joints.
 - 4. Pipe bends and loops.
 - 5. Alignment guides and anchors.

1.3 DEFINITIONS

- A. BR: Butyl rubber.
- B. Buna-N: Nitrile rubber.
- C. CR: Chlorosulfonated polyethylene synthetic rubber.
- D. CSM: Chlorosulfonyl-polyethylene rubber.
- E. EPDM: Ethylene-propylene-diene terpolymer rubber.
- F. NR: Natural rubber.

1.4 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.
- E. Maintenance Data: For pipe expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 EXPANSION JOINTS

- A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with external tie rods.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adsco Manufacturing, LLC.
 - b. Anamet, Inc.
 - c. Badger Industries.
 - d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex-Pression, Ltd.
 - h. Flex-Weld, Inc.
 - i. Hyspan Precision Products, Inc.
 - j. Metraflex, Inc.

- k. Piping Technology & Products, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics, Inc.; Pathway Division.
 - n. Tozen America Corp.
 - o. Unaflex Inc.
 - p. WahlcoMetroflex.
 2. Metal-Bellows Expansion Joints for Copper Piping: Single- or multiple -ply phosphor-bronze bellows, copper pipe end connections, and brass shrouds.
 3. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections, and steel shroud.
 4. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple -ply stainless-steel bellows, steel pipe end connections, and carbon-steel shroud.
 5. Minimum Pressure Rating: 150 psig (1035 kPa), unless otherwise indicated.
 6. Configuration: Single- or double -bellows type with base, unless otherwise indicated.
 7. End Connections: Flanged .
- B. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Weld, Inc.
 - d. Garlock Sealing Technologies.
 - e. General Rubber Corp.
 - f. Mason Industries, Inc.; Mercer Rubber Co.
 - g. Metraflex, Inc.
 - h. MG Piping Products Co.
 - i. Proco Products, Inc.
 - j. Red Valve Company, Inc.
 - k. Senior Flexonics, Inc.; Pathway Division.
 - l. Tozen America Corp.
 - m. Unaflex Inc.
 - n. Vibration Mountings & Controls, Inc.
 2. Arch Type: Single or multiple arches.
 3. Spherical Type: Single or multiple spheres.
 - a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4 (DN 40 to DN 100): 150 psig (1035 kPa) at 220 deg F (104 deg C).
 - b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6 (DN 125 and DN 150): 140 psig (966 kPa) at 200 deg F (93 deg C).
 - c. Minimum Pressure and Temperature Ratings for NPS 8 to NPS 12 (DN 200 to DN 300): 140 psig (966 kPa) at 180 deg F (82 deg C).
 4. Material: Buna-N .

5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
- C. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Pression, Ltd.
 - d. Metraflex, Inc.
 2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- joint end connections.
 - a. **NPS 2 (DN 50)** and Smaller: Bronze hoses and single-braid bronze sheaths with **450 psig at 70 deg F (3100 kPa at 21 deg C)** and **340 psig at 450 deg F (2340 kPa at 232 deg C)** ratings.
 - b. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Stainless-steel hoses and single-braid, stainless-steel sheaths with **300 psig at 70 deg F (2070 kPa at 21 deg C)** and **225 psig at 450 deg F (1550 kPa at 232 deg C)** ratings.
 3. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- joint end connections.
 - a. **NPS 2 (DN 50)** and Smaller: Bronze hoses and double-braid bronze sheaths with **700 psig at 70 deg F (4830 kPa at 21 deg C)** and **500 psig at 450 deg F (3450 kPa at 232 deg C)** ratings.
 - b. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Stainless-steel hoses and double-braid, stainless-steel sheaths with **420 psig at 70 deg F (2890 kPa at 21 deg C)** and **315 psig at 450 deg F (2170 kPa at 232 deg C)** ratings.

2.2 ALIGNMENT GUIDES

- A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adsko Manufacturing, LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.

- h. Piping Technology & Products, Inc.
- i. Senior Flexonics, Inc.; Pathway Division.

2.3 MATERIALS FOR ANCHORS

- A. Steel Shapes and Plates: ASTM A 36/A 36M.
- B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Stud: Threaded, zinc-coated carbon steel.
 - 2. Expansion Plug: Zinc-coated steel.
 - 3. Washer and Nut: Zinc-coated steel.
- E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
 - 1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - 2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - 3. Washer and Nut: Zinc-coated steel.
- F. Concrete: Portland cement mix, 3000 psi (20.7 MPa) minimum. Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.
- G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- B. Install expansion joints of sizes matching size of piping in which they are installed.

- C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Attach pipe bends and loops to anchors.
 - 1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.3 SWING CONNECTIONS

- A. Connect risers and branch connections to mains with at least **[five]** **<Insert number>** pipe fittings, including tee in main.
- B. Connect risers and branch connections to terminal units with at least **[four]** **<Insert number>** pipe fittings, including tee in riser.
- C. Connect mains and branch connections to terminal units with at least **[four]** **<Insert number>** pipe fittings, including tee in main.

3.4 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

- A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints are indicated.

- E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 15123

SECTION 15126 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

- B. Related Sections:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 15 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
3. Division 15 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Palmer - Wahl Instruments Inc.
 2. Terice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

- C. Case: Die-cast aluminum or brass , 7 inches (178 mm) long.
- D. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- E. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Window: Glass or plastic .
- G. Connector: Rigid, straight type.
- H. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ernst Gage Co.
 - 2. Eugene Ernst Products Co.
 - 3. Marsh Bellofram.
 - 4. Miljoco Corp.
 - 5. Terrice, H. O. Co.
 - 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 - 7. Winters Instruments.
- B. Case: Plastic, 7 inches (178 mm) long.
- C. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic.
- F. Connector: Rigid, straight type.
- G. Stem: Metal, for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 BIMETALLIC-ACTUATED DIAL THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Ernst Gage Co.
3. Eugene Ernst Products Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Terice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

- B. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.
- C. Case: Dry type, stainless steel with 5-inch (127-mm) diameter.
- D. Element: Bimetal coil.
- E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- F. Pointer: Red or other dark-color metal.
- G. Window: Glass or plastic .
- H. Ring: Stainless steel.
- I. Connector: Rigid, back type.
- J. Stem: Metal, for thermowell installation and of length to suit installation.
- K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AMETEK, Inc.; U.S. Gauge Div.
 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
 3. Ernst Gage Co.
 4. Marsh Bellofram.
 5. Miljoco Corp.
 6. NANMAC Corporation.
 7. Noshok, Inc.

8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Terice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Manufacturers: Same as manufacturer of thermometer being used.

C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.5 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.
5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Terice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, metal or plastic, 4-1/2-inch (114-mm) diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic .
8. Ring: Metal or plastic.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.

10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Terice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.

E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be 0 to 200 psig (0 to 1380 kPa).
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F (minus 4 to plus 52 deg C).
3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F (minus 18 to plus 104 deg C).

4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the outlet of each domestic, hot-water storage tank.
- B. Provide the following temperature ranges for thermometers:
 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions).
 2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions).

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- E. Install remote-mounting pressure gages on panel.
- F. Install needle-valve and snubber fitting in piping for each pressure gage.
- G. Install test plugs in tees in piping.
- H. Install permanent indicators on walls or brackets in accessible and readable positions.
- I. Install connection fittings for attachment to portable indicators in accessible locations.
- J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- K. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 15126

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Escutcheons.
6. Sleeves and sleeve seals.
7. Wall penetration systems.

- B. Related Section:

1. Division 2 Section "Water Distribution" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to local codes .

1.4 SUBMITTALS

- A. Product Data: For the following products:

1. Specialty valves.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Owner's written permission.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: **ASTM B 88, Type L** (**ASTM B 88M, Type B**) water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100):** Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) NVent LLC or approved equal.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- 7. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Victaulic Company.
 - b. Copper Grooved-End Fittings: **ASTM B 75 (ASTM B 75M)** copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: **ASTM B 88, Type K (ASTM B 88M, Type A)** and **ASTM B 88, Type L (ASTM B 88M, Type B)** water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. **NPS 3 and NPS 4 (DN 80 and DN 100):** Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or Tube.
- C. Material: LLDPE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- D. Color: Black or Natural.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Charlotte Pipe and Foundry Company.

- b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - 2. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 - 2. Description: PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.

- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Factory-fabricated, bolted, companion-flange assembly.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig (1035 kPa).
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Calpico, Inc.
- b. Lochinvar Corporation.

2. Description:

- a. Galvanized-steel coupling.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Perfection Corporation; a subsidiary of American Meter Company.
- b. Precision Plumbing Products, Inc.
- c. Victaulic Company.

2. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.8 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated or rough-brass finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.

- E. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.10 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel .

3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.11 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. SIGMA or approved equal.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 3. Housing-to-Sleeve Gasket: EPDM rubber.
 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.12 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping adjacent to equipment and specialties to allow service and maintenance.
- O. Install piping to permit valve servicing.
- P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- Q. Install piping free of sags and bends.
- R. Install fittings for changes in direction and branch connections.

- S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- T. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- U. Install thermostats in hot-water circulation piping. Comply with requirements in Division 15 Section "Domestic Water Pumps" for thermostats.
- V. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or gate valves for piping **NPS 2-1/2 (DN 65)** and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping **NPS 2 (DN 50)** and smaller and butterfly valves for piping **NPS 2-1/2 (DN 65)** and larger. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. **NPS 1-1/2 (DN 40)** and Smaller: Fitting-type coupling.
 - 2. **NPS 2 (DN 50)** and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for **NPS 2 (DN 50)** and Smaller: Use dielectric couplings or nipples.

- C. Dielectric Fittings for **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Use dielectric flanges .
- D. Dielectric Fittings for **NPS 5 (DN 125)** and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. **100 Feet (30 m)** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet (30 m)**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet (30 m)** If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs **100 Feet (30 m)** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of **3/8 inch (10 mm)**.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. **NPS 3/4 (DN 20)** and Smaller: **60 inches (1500 mm)** with **3/8-inch (10-mm)** rod.
 - 2. **NPS 1 and NPS 1-1/4 (DN 25 and DN 32)**: **72 inches (1800 mm)** with **3/8-inch (10-mm)** rod.
 - 3. **NPS 1-1/2 and NPS 2 (DN 40 and DN 50)**: **96 inches (2400 mm)** with **3/8-inch (10-mm)** rod.
 - 4. **NPS 2-1/2 (DN 65)**: **108 inches (2700 mm)** with **1/2-inch (13-mm)** rod.
 - 5. **NPS 3 to NPS 5 (DN 80 to DN 125)**: **10 feet (3 m)** with **1/2-inch (13-mm)** rod.
 - 6. **NPS 6 (DN 150)**: **10 feet (3 m)** with **5/8-inch (16-mm)** rod.
 - 7. **NPS 8 (DN 200)**: **10 feet (3 m)** with **3/4-inch (19-mm)** rod.
- F. Install supports for vertical copper tubing every **10 feet (3 m)**.

- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for **NPS 2-1/2 (DN 65)** and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish stamped steel with set screw or spring clips.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish .
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish stamped steel with set screw or spring clips.
 - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw stamped steel with set screw or spring clips.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 - 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - 2. Insulated Piping: Split plate, stamped steel with concealed or exposed-rivet hinge and spring clips.

3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge and spring clips.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split plate, stamped steel with concealed hinge and set screw.
5. Bare Piping in Unfinished Service Spaces: Split plate, stamped steel with concealed hinge and set screw or spring clips .
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE .
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe .
 - a. Extend sleeves 2 inches (50 mm) above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished

floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. PVC pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE .
5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
 - b. Cast-iron wall pipe sleeves for pipes **NPS 6 (DN 150)** and larger.
 - c. Install sleeves that are large enough to provide **1-inch (25-mm)** annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC pipe sleeves for pipes smaller than **NPS 6 (DN 150)**.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with local codes.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 6. Prepare reports for tests and for corrective action required.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.16 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.17 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least **50 ppm (50 mg/L)** of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least **200 ppm (200 mg/L)** of chlorine. Isolate and allow to stand for three hours.

- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, **NPS 3 (DN 80)** and smaller, shall be the following:
 - 1. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A)**; wrought-copper solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, **NPS 4 to NPS 8 (DN 100 to DN 200)** and larger, shall be one of the following:
 - 1. Soft copper tube, **ASTM B 88, Type K (ASTM B 88M, Type A)**; wrought-copper solder-joint fittings; and brazed joints.
 - 2. PVC, Schedule 80 pipe; PVC, Schedule 80 socket fittings; and solvent-cemented joints.
- F. Aboveground domestic water piping, shall be the following:

1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
2. Hard copper tube, **ASTM B 88, Type L (ASTM B 88M, Type B)**; cast- or wrought-copper solder-joint fittings; and soldered joints.

3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly, ball, or gate valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 2. Throttling Duty: Use ball or globe valves for piping **NPS 2 (DN 50)** and smaller. Use butterfly or ball valves with flanged ends for piping **NPS 2-1/2 (DN 65)** and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 15140

SECTION 15145 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Water pressure-reducing valves.
 - 2. Strainers.
 - 3. Hose bibbs.
 - 4. Drain valves.
 - 5. Water hammer arresters.
- B. Related Sections include the following:
 - 1. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 15 Section "Domestic Water Piping" for water meters.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
5. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Water Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CLA-VAL Automatic Control Valves.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts Industries, Inc.; Ames Fluid Control Systems.
 - e. Watts Industries, Inc.; Watts ACV.
 - f. Zurn Plumbing Products Group; Wilkins Div.
3. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa) minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
5. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Trim: Stainless steel.

6. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 (DN 65)** and larger.

2.2 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
3. Type: Ball valve with two readout ports and memory setting indicator.
4. Body: Brass or bronze,
5. Size: Same as connected piping, but not larger than **NPS 2 (DN 50)**.
6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: **400-psig (2760-kPa)** minimum CWP.
5. Size: **NPS 2 (DN 50)** or smaller.

6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.3 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm).
6. Drain: Factory-installed, hose-end drain valve.

2.4 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include wall flange with each chrome- or nickel-plated hose bibb.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.

- h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASSE 1010 or PDI-WH 201.
 - 4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve.
- F. Install water hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Water pressure-reducing valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."

3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.

END OF SECTION 15145

SECTION 15410 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Protective shielding guards.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.

- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
4. Install guards on existing fixtures indicated on the drawings.

B. Protective Shielding Piping Enclosures,:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc. or approved equal.
3. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fixtures to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410

SECTION 15450 - POTABLE-WATER STORAGE TANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes potable-water storage tanks and related accessories for indoor installation.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. HDPE: High-density polyethylene plastic.
- C. LDPE: Low-density polyethylene plastic.
- D. PE: Polyethylene plastic.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories. Indicate dimensions, wall thickness, insulation, finishes and coatings, required clearances, methods of assembly of components, and piping connections.
- B. Manufacturer Seismic Qualification Certification: Submit certification that indicated steel, potable-water storage tanks, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- C. Manufacturer Certificates: Signed by manufacturers certifying that potable-water storage tanks comply with requirements.
- D. Source quality-control test reports.
- E. Purging and disinfecting reports.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of potable-water storage tanks and are based on the specific system indicated.
- B. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 to 9," for potable-water storage tanks. Include appropriate NSF marking.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL, PRECHARGED, PRESSURE, POTABLE-WATER STORAGE TANKS

- A. Steel, Precharged, Diaphragm, Water Storage Tanks:
 - 1. Manufacturers:
 - a. AMTROL, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Flexcon Industries; Plumbing & Heating Division.
 - d. Myers, F. E..
 - e. Smith, A. O.; Aqua-Air Div.
 - f. State Industries, Inc.
 - g. Taco, Inc.
 - h. Wessels Co.
 - 2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.

3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 4. Operation: Factory-installed, butyl-rubber diaphragm.
- B. Steel, Precharged, Bladder, Water Storage Tanks:
1. Manufacturers:
 - a. Armstrong Pumps, Inc.
 - b. Taco, Inc.
 - c. Wessels Co.
 - d. Wood, John Co.
 2. Description: Steel, vertical, pressured-rated tank with cylindrical sidewalls and with air-charging valve and air precharge.
 3. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
 4. Operation: Factory-installed, butyl-rubber bladder.
- C. Construction: Steel, constructed with nontoxic welded joints, for 125-psig (860-kPa) working pressure.
- D. Tappings: Factory-fabricated stainless steel, welded to tank.
1. NPS 2 (DN 50) and Smaller: ASME B1.20.1, with female thread.
 2. NPS 2-1/2 (DN 65) and Larger: ASME B16.5, flanged.
- E. Specialties and Accessories: Include tappings in tank and the following:
1. Pressure gage.
- F. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank.
- G. Tank Interior Finish: Materials and thicknesses complying with NSF 61 barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
1. Lining Material: Copper.
 2. Coating: Epoxy resin, Glass, or Nickel.
- H. Exterior Coating: Manufacturer's standard enamel paint .

2.3 SOURCE QUALITY CONTROL

- A. Test and inspect potable-water storage tanks according to the following tests and inspections and prepare test reports:
1. Pressure Testing for Non-ASME-Code, Pressure, Potable-Water Storage Tanks: Hydrostatically test to ensure structural integrity and freedom from leaks at

pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Fill tanks with water, vent air, pressurize tanks, disconnect test equipment, hold pressure for two hours with no drop in pressure, and check for leaks. Repair or replace tanks that fail test with new tanks and repeat until test is satisfactory.

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Install concrete bases of dimensions indicated for tanks. Refer to Division 15 Section "Basic Mechanical Materials and Methods."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
 - 2. For supported tanks, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported tanks.
- B. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.2 INSTALLATION

- A. Install water storage tanks on concrete bases, level and plumb, firmly anchored. Arrange so devices needing servicing are accessible.
 - 1. Install horizontal tanks on concrete piers and factory-fabricated saddles.
- B. Anchor tank supports and tanks to substrate.
 - 1. Use steel or FRP straps over or around plastic tanks.
- C. Install tank seismic restraints.
- D. Install thermometers and pressure gages on water storage tanks and piping, if indicated. Thermometers and pressure gages are specified in Division 15 Section "Meters and Gages."
- E. Install the following devices on tanks where indicated:
 - 1. Pressure relief valves.
 - 2. Temperature and pressure relief valves.
 - 3. Vacuum relief valves.

4. Tank vents on nonpressure tanks.
5. Connections to accessories.

F. After installing tanks with factory finish, inspect finishes and repair damages to finishes.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to potable-water storage tanks to allow service and maintenance.
- C. Connect water piping to water storage tanks with unions or flanges and with shutoff valves. Connect tank drains with shutoff valves and discharge over closest floor drains.
 1. General-duty valves are specified in Division 15 Section "Valves."
 - a. Valves **NPS 2 (DN 50)** and Smaller: Gate or ball.
 - b. Valves **NPS 2-1/2 (DN 65)** and Larger: Gate or butterfly.
 - c. Drain Valves: **NPS 3/4 (DN 20)** gate or ball valve. Include outlet with, or nipple in outlet with, ASME B1.20.7, 3/4-11.5NH thread for garden-hose service, threaded cap, and chain.
 2. Water Piping Connections: Make connections to dissimilar metals with dielectric fittings. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."
 3. Connect air piping to hydropneumatic tanks with unions or flanges and gate or ball valves. Make connections to dissimilar metals with dielectric fittings, which are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.4 FIELD QUALITY CONTROL

- A. Perform the following final checks before filling:
 1. Verify that air precharge in precharged tanks is correct.
 2. Test operation of tank accessories and devices.
 3. Verify that pressure relief valves have correct setting.
 - a. Manually operate pressure relief valves.
 - b. Adjust pressure settings.
 4. Verify that vacuum relief valves are correct size.
 - a. Manually operate vacuum relief valves.
 - b. Adjust vacuum settings.

- B. Filling Procedures: Follow manufacturer's written procedures. Fill tanks with water to operating level.

3.5 CLEANING

- A. Clean and disinfect potable-water storage tanks.
- B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, use procedure described in AWWA C652 or as described below:
 - 1. Purge water storage tanks with potable water.
 - 2. Disinfect tanks by one of the following methods:
 - a. Fill tanks with water-chlorine solution containing at least 50 ppm (50 mg/L) of chlorine. Isolate tanks and allow to stand for 24 hours.
 - b. Fill tanks with water-chlorine solution containing at least 200 ppm (200 mg/L) of chlorine. Isolate tanks and allow to stand for three hours.
 - 3. Flush tanks, after required standing time, with clean, potable water until chlorine is not present in water coming from tank.
 - 4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination made by authorities having jurisdiction shows evidence of contamination.
- C. Prepare written reports for purging and disinfecting activities.

END OF SECTION 15450

SECTION 15486 - FUEL-FIRED WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following fuel-fired water heaters:
 - 1. Commercial, atmospheric, storage, gas water heaters.

1.3 DEFINITIONS

- A. LP Gas: Liquefied-petroleum fuel gas.

1.4 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.
- B. Coordinate installation so that heating coils in heat exchanger may be periodically cleaned. Provide unions for all connecting piping to facilitate the removal of piping. Provide combination temperature and pressure relief valve piped to adequate drain. Where feasible, install flexible connections and tie-down straps to accommodate movement during seismic events.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period(s): From date of Substantial Completion:
 - a. Commercial, Gas Water Heaters:
 - 1) Storage Tank: 20 years.
 - 2) Controls and Other Components: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, Atmospheric, Storage, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Manufacturers:
 - a. American Water Heater Company.
 - b. Bock Water Heaters, Inc.
 - c. Bradford White Corporation.
 - d. GSW Water Heating Company.
 - e. HESco Industries, Inc.
 - f. Lochinvar Corporation.
 - g. PVI Industries, LLC.
 - h. Rheem Water Heater Div.; Rheem Manufacturing Company.
 - i. Ruud Water Heater Div.; Rheem Manufacturing Company.
 - j. Smith, A. O. Water Products Company.
 - k. State Industries, Inc.
2. Storage-Tank Construction: Non-ASME-code steel with 150-psig (1035-kPa) working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Lining: Nickel plate complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
3. Factory-Installed, Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
 - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner: For use with atmospheric water heaters and for natural-gas fuel.
 - g. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
 - h. Temperature Control: Adjustable thermostat.
 - i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - j. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
4. Special Requirements: NSF 5 construction.
 5. Draft Hood: Draft diverter; complying with ANSI Z21.12.
 6. Automatic Damper: ANSI Z21.66, [electrically operated] [mechanically activated] [thermally activated], automatic-vent-damper device with size matching draft hood.
 7. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
 8. Capacity and Characteristics:
 - a. Capacity: <Insert gal. (L).>
 - b. Recovery: <Insert gph (L/s)> at [100 deg F (56 deg C)] <Insert deg F (deg C)> temperature rise.
 - c. Temperature Setting: [125 deg F (52 deg C)] [140 deg F (60 deg C)] <Insert temperature>.
 - d. Fuel Gas Demand: <Insert cfh (L/s).>
 - e. Fuel Gas Input: <Insert Btu/h (W).>
 - f. Gas Pressure Required at Burner: <Insert psig (kPa) or inches (mm)> water column.
 - g. Electrical Characteristics:
 - 1) Volts: [120] [240] [277] [480] <Insert value>.
 - 2) Phase: [Single] [Three].
 - 3) Hertz: 60.
 - 4) Full-Load Amperes: <Insert value.>
 - 5) Minimum Circuit Ampacity: <Insert value.>
 - 6) Maximum Overcurrent Protection: <Insert value.>
 - h. Minimum Vent Diameter: <Insert inches (mm).>

2.3 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
- E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
 - 1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
- F. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch-(457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN 25) drain outlet with ASME B1.20.1 pipe thread.
- G. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Provide dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
- H. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- I. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
- J. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- K. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.4 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

- C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install seismic restraints for commercial water heaters. Anchor to substrate.
- D. Install gas water heaters according to NFPA 54.
- E. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- F. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
- G. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- H. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.
- J. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.
- K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 15 Section "Meters and Gages" for pressure gages.
- L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Valves"

for general-duty valves and to Division 15 Section "Meters and Gages" for thermometers.

- M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- N. Fill water heaters with water.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- C. Ground equipment according to Division 16 Section "Grounding and Bonding."
- D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters.

END OF SECTION 15486

SECTION 15855A - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Louvers.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

- 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.
- B. Samples: 3 samples of each type of finish furnished.
- C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.
- B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 LOUVERS

- A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.
- C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.
- D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.
- E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

- F. Louver Finish: Louver finish shall be anodized aluminum in color as selected by the Architect.
- G. Manufacturer: Subject to compliance with requirements, provide louvers of one of the following:
 - 1. Air Guide.
 - 2. Airline Products Co.
 - 3. Airolite Co.
 - 4. American Warming & Ventilating Inc.
 - 5. Arrow United Industries, Inc.
 - 6. Carnes, Co.
 - 7. Cesco.
 - 8. Construction Specialties, Inc.
 - 9. Daniel.
 - 10. Dowco Corp.
 - 11. Greenheck.
 - 12. Industrial Louvers, Inc.
 - 13. Louvers & Dampers, Inc.
 - 14. Penn Ventilator Co., Inc.
 - 15. Reliable.
 - 16. Ruskin Mfg. Co.
 - 17. Safe-Air Inc.
 - 18. Snyder (E.G.) Co., Inc.
 - 19. Vent Products Co., Inc.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS

- A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 15855A